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POSTOPERATIVE POTASSIUM DEFICIT AND METABOLIC ALKALOSIS*

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POSTOPERATIVE apathy, lethargy, anorexia, weakness, abdominal distention and hypochloremia constitute a syndrome that has been described by such terms as "pancreatic asthenia"[1] and "la maladie post-opératoire."[2] It has been noted that these poorly understood symptoms, together with hypochloremia and alkalosis, develop in certain patients after major surgical operations in spite of the administration of glucose solutions and adequate or massive amounts of sodium chloride.[3, 4] Both symptoms and electrolyte changes were observed to improve, however, as soon as these patients began to eat. Whipple[5] has reported unexplained deaths following surgery of the biliary tract and pancreas in patients who showed marked apathy, weakness and anorexia. Death, with negative findings at autopsy, has been described by Brunschwig[6] in a patient who exhibited drowsiness, lethargy, weakness, twitching, shallow, infrequent respirations and hypochloremia after operation. In a preliminary report Pearson and Eliel[7] described a syndrome in 15 patients characterized by similar symptoms, low serum potassium, metabolic alkalosis, hypochloremia and electrocardiographic changes typical of potassium deficit, all of which return to normal upon administration of potassium chloride. Many of the patients had lost no gastrointestinal fluids and evidence was presented that the syndrome may result from adrenocortical hyperfunction. We have since observed the syndrome in an additional 17 patients. Within recent months several other investigators have reported the occurrence of potassium deficit and metabolic alkalosis in postoperative patients, most of whom, however, had lost large quantities of gastrointestinal fluids.[8-11]

In this report the clinical and laboratory findings in 32 postoperative patients are presented. Three patients are described in detail. Data from these and the remaining 29 cases are summarized in Tables 1 to 4.

The patients in this study were from the surgical services of Memorial Hospital.§ They were brought to our attention because of hypochloremia resistant to sodium chloride administration, elevation of serum carbon dioxide content, electrocardiographic changes or striking symptomatology. Some patients were studied throughout the postoperative course when it was anticipated that the extent of the surgical procedure would predispose to development of the syndrome. All the patients had undergone major surgical procedures for excision of suspected or proved neoplasms.

METHODS

Serum and erythrocyte sodium and potassium concentrations were determined on a flame photometer, with lithium as an internal standard.[12]

Concentrations per liter of erythrocytes were computed by means of the following formula:

$$K_c = \frac{K_b - (1 - V_c) \times K_s}{V_c}$$

where K_c, K_b and K_s are the erythrocyte, whole blood and serum concentrations, respectively, in milliequivalents per liter, and V_c is the hematocrit expressed as a fraction of 1. Serum chloride was determined by the method of Van Slyke and Sendroy[13]¶ and in some cases by that of Wilson and Ball,[14] serum phosphorus by the method of Fiske and Subbarow,[15]¶ serum calcium by the method of Clark and Collip,[16]¶ serum magnesium by a modification of Briggs's method,[17] serum pH by the colorimetric method of Hastings and Sendroy[18] adapted to a Klett photocolorimeter, serum carbon dioxide content by the method of Van Slyke[19] and total serum protein by the falling-drop method of Barbour and Hamilton.[20]¶

Sodium and bromide spaces were determined by the simultaneous intravenous injection of approximately 100 μc each of radiosodium (Na^{24}) and radio-

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¶These determinations were done in the Clinical Biochemistry Laboratory.

bromide (Br^{82}).[21] In some cases stable bromide (Br^{80}) was used. Heparinized venous blood samples were withdrawn at intervals of four and five and a half hours after injection and served as duplicate checks. Measurements of urine excretion invariably showed losses of less than 1 per cent and were therefore ignored. When stable bromide was used, serum bromide levels, prior to and after injection, were determined by the method of Brodie and Friedman.[22]* Spaces were computed with the use of Moore's[23] formula. Plasma concentrations were corrected for solids and the Donnan factor. The distribution and behavior of bromide were assumed for practical purposes to be the same as those of chloride,[24] and since chloride is largely an extracellular ion, changes in the bromide space were assumed to represent similar changes in extracellular fluid volume. The sodium space is a resultant of extracellular fluid volume and intracellular sodium content. Changes in the sodium space that could not be accounted for by changes in the bromide space were assumed, therefore, to represent changes in intracellular sodium content.

TABLE 1. *Serum Chemical Concentrations in 29 Cases of Postoperative Potassium Deficit and Metabolic Alkalosis.*

Case No.	Memorial Hospital Unit No.	Age	Sex	Diagnosis	Loss of Fluid from Gastrointestinal Tract	Adequate Water and Sodium Chloride Replacement
		yr,				
4	84277	51	F	Carcinoma of uterus	+	+
5	93125	45	F	Carcinoma of cervix	0	+
6	95913	57	F	Carcinoma of cervix†	+	+
7	82131	50	F	Carcinoma of cervix†	+	+
8	94319	55	F	Carcinoma of vagina	+	+
9	93311	45	F	Carcinoma of vulva	+	+
10	93061	43	F	Carcinoma of urethra†	+	+
11	93228	65	M	Carcinoma of b'adder†	+	−
12	93544	53	M	Carcinoma of bladder	0	+
13	93963	54	M	Carcinoma of bladder†	+	−
14	93777	59	M	Carcinoma of bladder	+	−
15	71459	46	F	Diverticulitis	+	−
16	93126	67	M	Carcinoma of rectum	+	+
17	94812	65	F	Carcinoma of rectum	0	+
18	81707	55	M	Carcinoma of colon	+	−
19	92305	57	F	Carcinoma of pancreas	+	−
20	92940	56	M	Carcinoma of pancreas	+	+
21	95379	71	M	Carcinoma of pancreas	+	+
22	95051	56	F	Carcinoma of pancreas	+	+
23	94008	71	F	Pancreatitis	+	+
24	94134	60	M	Carcinoma of stomach	0	+
25	93682	64	M	Carcinoma of stomach	+	+
26	94711	56	F	Carcinoma of stomach	+	+
27	94518	55	M	Sarcoma of stomach	0	+
28	95021	59	M	Peptic ulcer	+	+
29	95280	64	M	Peptic ulcer	+	+
30	90091	36	F	Carcinoma of esophagus	0	+
31	95997	63	M	Carcinoma of esophagus	0	+
32	95302	67	F	Carcinoma of esophagus	0	+

*The normal range of values is as follows: potassium, 3.8–5.0 milliequiv. per liter; pH, 7.35–7.43; carbon dioxide, 23–28 millimols per liter; chloride, 98–106 milliequiv. per liter; calcium, 9–10.5 mg. per 100 cc.; phosphorus, 2.5–4.0 mg. per 100 cc.; magnesium, 1–2 milliequiv. per liter; and protein, 6–7.5 gm. per 100 cc.

†Postoperative death.

TABLE 2. *Erythrocyte Sodium and Potassium Concentrations Occurring in 5 Cases of Postoperative Potassium Deficit and Metabolic Alkalosis.*

Case	Post-operative Day	Serum Potassium	Erythrocyte Sodium	Erythrocyte Potassium
		milliequiv. liter	*milliequiv. liter**	*milliequiv. liter**
1	0	3.6	20.9	109.3
	13	2.7	34.0	93.0
11	0	5.1	12.8	100.9
	7	3.6	19.8	94.3
17	0	4.6	29.6	103.3
	6	2.3	41.4	99.6
24	0	4.2	18.3	108.7
	7	3.5		87.5
25	0	5.2	36.4	107.6
	13	4.2	33.9	107.2

*Per liter of packed erythrocytes.

TABLE 3. *Symptoms and Signs Occurring in 32 Cases of Postoperative Potassium Deficit and Metabolic Alkalosis.*

Symptom or Sign	No. of Patients
Patients with specific symptoms:	30
Lethargy, apathy and depression	17
Nervousness, irritability and apprehension	7
Confusion, disorientation, delirium or hallucinosis	4
Irregular pulse	5
Muscular twitching or tetany	3
Muscular weakness	13
Abdominal distention and cramps	19
Anorexia, nausea or vomiting	15
Ileus*	7
Shallow respirations	1
Edema	9
Patients without specific symptoms	2
Total	32

*X-ray evidence in 6; absent peristalsis in 1.

*We are indebted to Dr. Eugene Y. Berger, Third (New York University) Research Service, Goldwater Memorial Hospital, New York City, for help in setting up the space determinations and for the bromide analyses.

Case Reports*

Case 1. R. H. (M.H.93377),† a 49-year-old Negress, was admitted for excision of an advanced carcinoma of the cervix (League of Nations, Grade IV). Her weight had fallen from 110 to 85 pounds during the 2 years prior to operation, but her medical status was otherwise good. At operation the uterus, adnexa, vagina, bladder, pelvic floor and lymph nodes and rectum were removed. The ureters were implanted in the colon, and a colostomy established. During the operation 4000 cc. of citrated whole blood was given.

The patient remained well hydrated throughout the postoperative period. She was maintained for 17 days on parenterally administered fluids, which consisted of isotonic sodium chloride solution, dextrose in water and protein hydrolysate solution. She also received 2000 cc. of blood. Sodium chloride was administered in amounts calculated to replace gastrointestinal and insensible losses.

Postoperatively, the patient's condition remained surprisingly good for 4 days, but on the 5th day she began to vomit and suction through a nasogastric tube was started. On the 7th day she was lethargic and weak, and the abdomen was distended. Mechanical obstruction of the small bowel in the pelvis was suspected. At this time the metabolic alkalosis and electrocardiographic changes described below were demonstrated.

Table 1 (*Concluded*).

Case No.	Post-operative day	Maximum Serum Chemical Deviations* Potassium	pH	Carbon dioxide content	Chloride	Calcium	Phosphorus	Magnesium	Protein
		milliequiv./liter		*millimols/liter*	*milliequiv./liter*	*mg./100 cc.*	*mg./100 cc.*	*milliequiv./liter*	*gm./100 cc.*
4	6	3.1	7.53	34.2	89.6	—	—	—	6.1
5	9	3.0	7.59	26.4	99.0	—	3.1	—	5.0
6	10	3.3	7.54	11.3	85.0	—	—	—	5.3
7	13	1.9	—	14.5	94.1	—	—	—	5.5
8	17	2.2	—	—	97.3	8.5	2.1	—	6.2
9	7	3.7	—	16.8	98.0	—	—	—	6.0
10	15	3.0	7.46	23.9	105.0	—	—	—	7.3
11	7	3.2	7.51	26.7	82.5	—	3.3	—	5.7
12	7	2.8	7.58	26.5	99.0	—	2.4	—	5.1
13	26	3.4	—	23.0	70.0	7.9	3.9	—	5.5
14	5	3.1	7.64	30.0	102.0	—	—	—	5.1
15	14	2.7	7.58	39.6	81.3	8.9	3.1	—	5.2
16	11	2.4	7.80	32.9	85.5	—	2.2	—	5.1
17	6	2.1	7.54	32.8	93.2	8.4	2.2	—	5.0
18	11	3.5	—	32.9	93.6	—	—	—	5.1
19	15	2.2	—	50.7	59.8	9.2	1.5	1.74	6.4
20	14	2.2	7.57	33.2	78.7	8.2	—	3.40	5.8
21	9	2.7	7.49	32.0	92.0	—	1.9	1.46	5.9
22	22	3.4	7.48	31.9	78.0	—	—	—	6.6
23	14	2.4	7.62	35.8	79.0	—	—	1.76	4.9
24	7	3.0	7.61	34.3	84.6	8.9	2.4	—	4.5
25	18	3.5	7.53	33.8	87.3	10.2	2.9	1.87	5.3
26	7	3.7	—	—	91.8	—	—	—	5.4
27	13	3.3	—	33.8	80.3	—	4.1	—	5.7
28	16	2.7	—	—	81.2	—	—	—	5.7
29	3	3.0	—	30.0	86.0	9.7	1.8	1.64	5.6
30	17	3.0	7.62	30.2	—	5.3	4.5	1.35	5.2
31	9	3.4	—	30.0	92.0	—	—	—	5.6
32	6	3.7	—	36.8	86.0	9.1	2.1	—	5.3

Table 4. *Electrocardiographic Abnormalities Occurring in 26 Cases of Postoperative Potassium Deficit and Metabolic Alkalosis.**

Abnormality	No. of Cases
Decreased amplitude of T waves	23
Depressed ST segments	19
Prolongation of QT interval	7
Frequent extrasystoles	2
Inversion of P waves (nodal rhythm)	1
Slurred QRS	1
Changes consistent with myocardial infarction	1

*No electrocardiograms were taken in 6 cases, and 1 patient had a normal tracing.

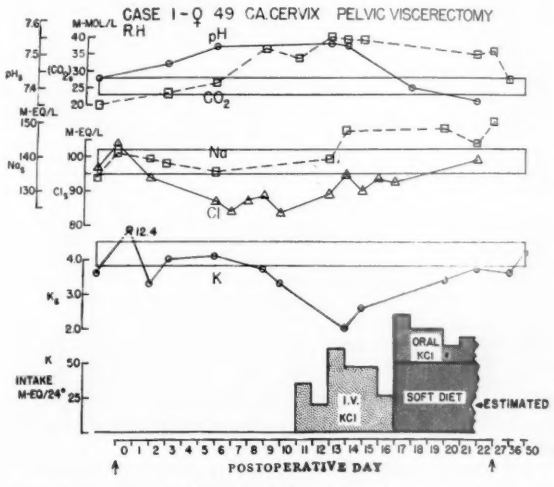

Figure 1. *Serum Chemical Concentrations and Potassium Intake in Case 1.*

The rectangular areas define normal ranges of concentration.

*We are indebted to Dr. Alexander Brunschwig for permission to report Cases 1 and 2 and to Dr. Gordon McNeer for permission to report Case 3.

†We are indebted for some of the serum pH, carbon dioxide, chloride and potassium values on this case to the Research Biochemistry Section of Sloan-Kettering Institute. This case is being reported in another connection by Drs. C. F. MacInnes, O. Bodansky and A. Brunschwig.

On the 10th day she complained of nausea and abdominal cramps. Small amounts of potassium chloride (40 milliequiv. per day, or 3 gm.) were given intravenously from the 11th day on because the serum potassium level had fallen to 3.4 milliequiv. per liter. In spite of this, all the symptoms and signs progressed. On the 13th day the dose of potassium chloride was increased to 60 milliequiv. (4.5 gm.). On the 14th day edema of the feet appeared. The patient looked very ill. The serum now showed persistent alkalosis and severe hypopotassemia (2.0 milliequiv. per liter). On the 15th day, however, she began to expel flatus freely through the colostomy, and by the 16th day a remarkable change in her condition had occurred. Apathy and lethargy diminished, and signs of ileus disappeared. On the 17th day she was able to take a soft diet, and convalescence proceeded uneventfully thereafter.

The blood chemical findings are summarized in Figure 1. A gradual rise in serum pH and carbon dioxide content and a fall in serum chloride occurred immediately after operation and continued, reaching their maximum deviations from normal on the 10th to 13th days. Electrocardiographic abnormalities (flattening of the T waves, prolongation of the QT interval and inversion of the P waves) first appeared on the 7th day (Fig. 2), although the serum potassium level was within normal limits at this time.

The serum potassium rose to 12.4 milliequiv. per liter on the 1st postoperative day, but fell promptly to normal. It began to fall below normal on the 9th day and reached its lowest level (2.0 milliequiv. per liter) on the 14th day. The clinical improvement that occurred on the 16th day coincided with a sharp fall in serum pH and a rise in serum potassium and chloride levels. The blood chemical values and the electrocardiogram did not return to normal until after discharge. Since clinical improvement did not occur until 4 days after the start of potassium chloride administration, it is assumed that the amount was suboptimal.

Simultaneous sodium (Na^{24}) and bromide spaces were determined preoperatively and on the 2nd and 15th postoperative days. The results (Fig. 3) show that at the time when symptoms and chemical abnormalities were at their peak, there was a shrinkage of the bromide space and a striking increase in the sodium space.

Case 2. D. H. (M.H.92755), a 64-year-old widow, had a radical hysterectomy and resection of the anterior wall of the rectum for advanced carcinoma of the uterus. She had lost only 6 pounds in the previous 2 years, and her general medical condition, preoperatively, was satisfactory. During the operation she received 2500 cc. of citrated whole blood. Postoperatively, dextrose in water and protein hydrolysate solution were administered intravenously. No sodium chloride was given. Food was withheld until the 6th day. There was no loss of gastrointestinal fluids from suction or vomiting.

The patient's condition appeared satisfactory during the first 2 postoperative days. On the 3rd day she was drowsy and apathetic. On the 4th day she felt tired and was lethargic and weak. At this time she was noted to have an irregular pulse, the blood pressure fell gradually, the pulse became weak and thready, and her condition appeared critical. Electrocardiographic findings (described below) suggested potassium deficit, and the serum potassium level was found to be 3.5 milliequiv. per liter; 40 milliequiv. (3 gm.) of potassium chloride was then administered every 6 hours by mouth. Within 12 hours dramatic improvement occurred. The pulse became regular, blood pressure rose to normal, and she appeared more alert. On the 6th day she began oral feedings, and convalescence proceeded uneventfully thereafter.

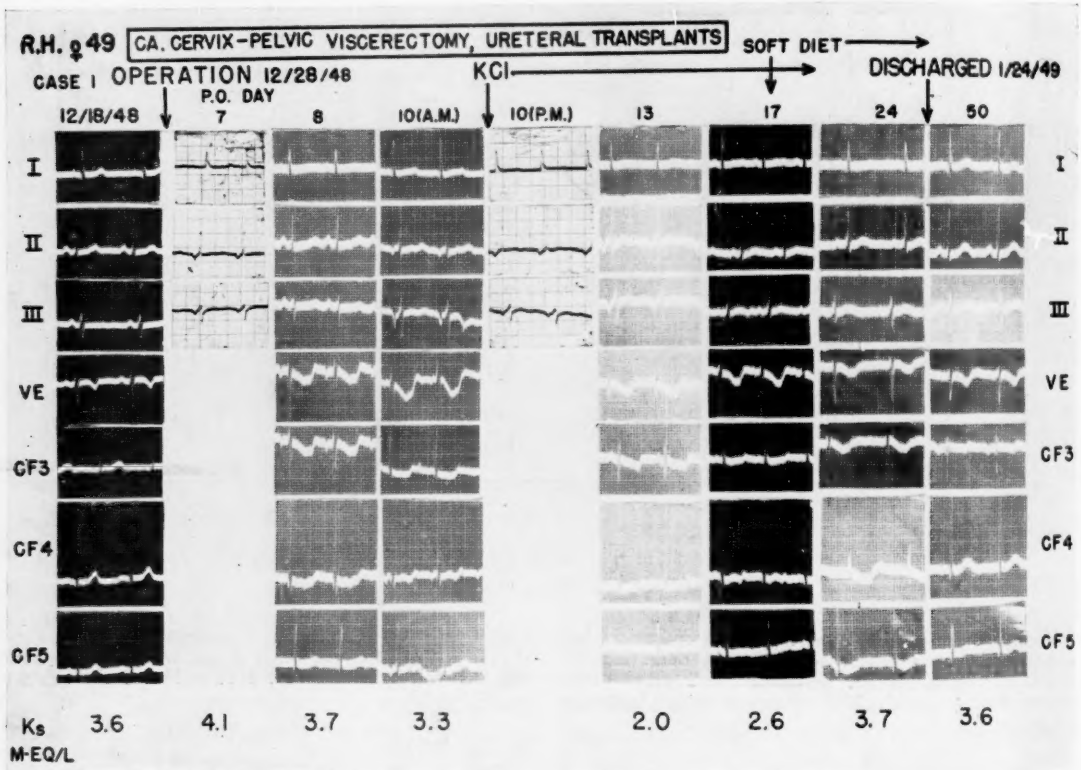

Figure 2. *Serial Electrocardiograms in Case 1.*
The postoperative day is given at the top of each tracing. The corresponding serum potassium concentration is given at the bottom.

The blood chemical findings (Fig. 4) showed that on the 4th postoperative day, when the patient's condition was critical, there was a marked metabolic alkalosis together with hypochloremia, hypopotassemia and hypoproteinemia. Within 12 hours of the administration of 8 gm. of potassium chloride, there was an abrupt rise in serum potassium and chloride and a definite fall in serum bicarbonate and pH.

The electrocardiographic tracings are illustrated in Figure 5. On the 4th postoperative day, the T wave in Lead 2 had disappeared, and frequent extrasystoles were seen to account for the irregular pulse. Within 12 hours of the administration of potassium chloride, the electrocardiogram had returned to a normal configuration.

Case 3. L. G. (M.H.93171), a 71-year-old woman, had a right colectomy and ileocolic anastomosis for carcinoma

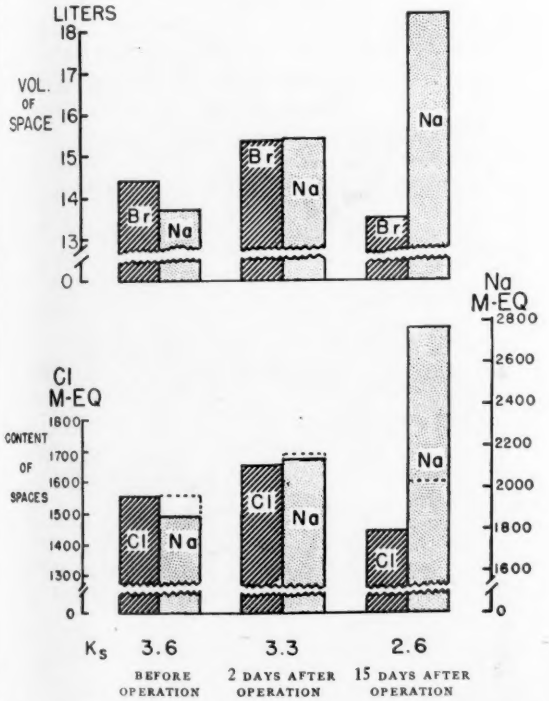

Figure 3. *Sodium (Na^{24}) and Bromide Spaces in Case 1. The lower half of the chart, showing the sodium and chloride content of the corresponding spaces, is so constructed that equal heights of the paired columns represent the existence of these two ions at their normal concentration ratio of 1.26:1 in extracellular water. The dotted lines represent the amount of sodium that could be accommodated in the simultaneously found bromide space at the existing concentration of sodium in extracellular water. Corresponding serum potassium concentrations are given below each determination.*

of the colon. At the same time she had a cholecystectomy for gallstones found at operation. She had lost 12 pounds in the previous 6 months, but otherwise was in good condition preoperatively. During the postoperative period dextrose in water and isotonic sodium chloride were given in amounts equal to estimated gastrointestinal and insensible losses. Between the 6th and 10th postoperative days she received 1500 cc. of citrated whole blood.

On the 1st postoperative day her condition was satisfactory. On the 2nd day the abdomen became distended, and she began to vomit small amounts of fluid frequently. Nasogastric tube drainage was started, with relief of vomiting and distention. The tube was withdrawn on the 4th day, but she was passing no flatus and abdominal distention recurred rapidly. A Miller–Abbott tube was passed, and nasogastric tube suction was reinstituted for 24 hours on the 5th day. On the 7th day an x-ray film of the abdomen showed numerous loops of dilated small bowel that suggested mechanical obstruction. On the 8th day persistent vomiting set in. Sluggish peristalsis was noted. The loss of gastric fluids, which had varied from 0 to 800 cc. per day, suddenly rose to 1500 cc. Gastric suction was resumed. On the 9th day the

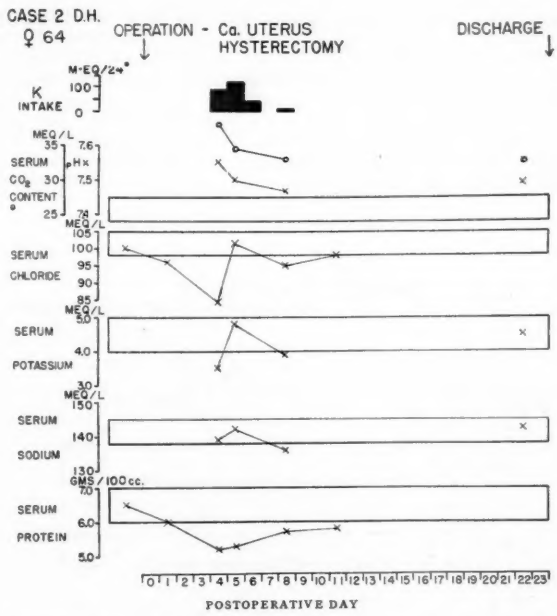

Figure 4. *Serum Chemical Concentrations and Potassium Intake in Case 2.*

patient's condition was becoming critical. The urinary output had been diminishing in spite of an ample fluid intake and slight edema of the ankles had appeared. Repeated

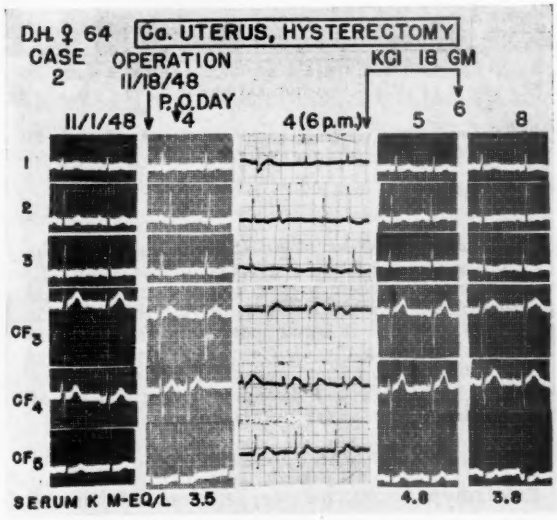

Figure 5. *Serial Electrocardiograms in Case 2.*

x-ray examinations showed fluid levels in the small bowel and some diminution in gas, but persistence of dilated loops. Surgical exploration was being considered when she was seen by a member of the medical service, who recognized

the syndrome from the symptoms, resistant hypochloremia and flattened T waves in the electrocardiogram. Operation was postponed. Potassium chloride by nasogastric tube and intravenously, totaling 100 milliequiv. per day (7.4 gm.), was started on the morning of the 10th day. By 6 p.m. of that day the patient had had two spontaneous bowel movements, and the distention was subsiding. Within 24 hours she looked and felt much better; both tubes were withdrawn, vomiting stopped, and the urinary output increased. Rapid improvement continued. The patient took a substantial soft diet on the 13th day and was discharged in excellent condition on the 18th postoperative day.

The chemical and electrocardiographic findings are presented in Figures 6 and 7. On the 9th postoperative day there was severe hypopotassemia, hypochloremia and hypoproteinemia. The electrocardiogram showed flattening

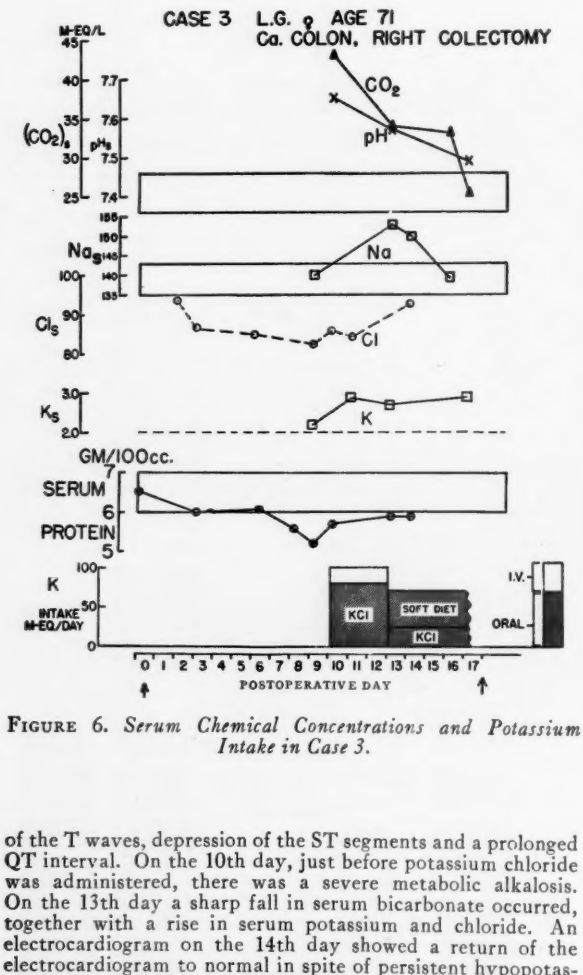

FIGURE 6. *Serum Chemical Concentrations and Potassium Intake in Case 3.*

of the T waves, depression of the ST segments and a prolonged QT interval. On the 10th day, just before potassium chloride was administered, there was a severe metabolic alkalosis. On the 13th day a sharp fall in serum bicarbonate occurred, together with a rise in serum potassium and chloride. An electrocardiogram on the 14th day showed a return of the electrocardiogram to normal in spite of persistent hypopotassemia. The alkalosis had disappeared at the time of discharge although the serum potassium remained low.

CLINICAL OBSERVATIONS

Electrolyte disturbances, similar to those described in the 3 cases reported above, have been observed in 29 additional postoperative patients on the various surgical services of Memorial Hospital during the past year. All patients, with 1 exception, had been maintained on parenteral administration of fluids without potassium and had had little or no oral intake during the period when hypopotassemia developed. One patient (Case 30) who was fed a well balanced diet by gastrostomy both preoperatively and postoperatively nevertheless developed hypopotassemia, hypochloremia and alkalosis, which responded to added potassium chloride. In 9 patients loss of gastrointestinal secretions was either absent or insignificant (Table 1), indicating that such losses are not essential to the development of the syndrome. In 17 patients

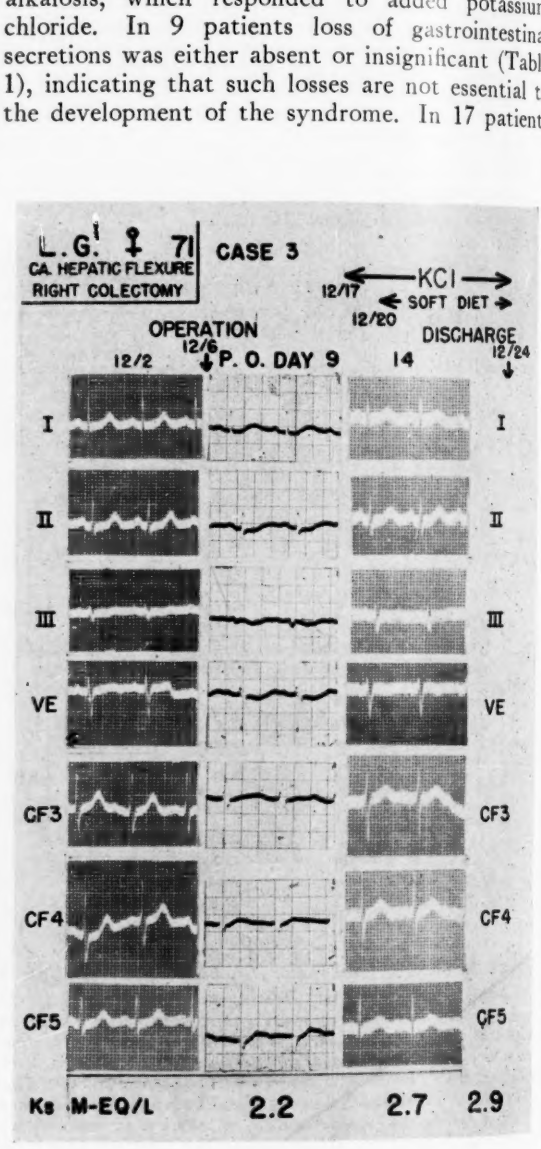

FIGURE 7. *Serial Electrocardiograms in Case 3.*

the losses were replaced by isotonic sodium chloride solution on a volume-for-volume basis. Six patients received less than volume-for-volume replacement.

Losses of gastrointestinal fluids undoubtedly contributed to deficits of electrolytes other than sodium and chloride. Prolonged or severe losses of such fluids, however, would be required to cause significant potassium deficit, since various intestinal secretions are relatively low in potassium content.[11] A loss of potassium in gastrointestinal fluids in excess of 100 milliequiv. probably did not occur in more than four patients. The greatest loss (190

milliequiv.) was found in a patient (Case 10) who lost 27 liters of fluid by tubal suction and ileostomy drainage before potassium therapy was started.

The blood chemical findings are summarized in Table 1. All the patients had a low serum potassium level. An associated alkalosis or hypochloremia (or both) was absent in 9 patients. In these patients the postoperative course had been complicated by such events as urinary-tract infection, ureteral obstruction, peritonitis, pelvic abscess, evisceration, fecal fistula or excessive loss of intestinal fluids. There were 5 postoperative deaths, all of which fell in this group. These complicating factors may account for the failure of alkalosis or hypochloremia to develop. There were no deaths that could be attributed directly to potassium deficit.

Serum calcium determinations on 12 patients revealed values slightly below normal in 3 with correction for serum protein. One patient (Case 30) had a very low level (5.3 mg. per 100 cc.) after a radical neck dissection, laryngectomy and cervical esophagectomy in which the parathyroid glands were probably removed. She manifested tetany, which did not respond to calcium gluconate, vitamin D or A.T. 10 but did respond to adequate doses of potassium chloride. Tetany or muscular twitching was seen in 2 other patients (Cases 19 and 27) with normal serum calcium levels.

Serum phosphorus determinations in 16 patients revealed low levels in 9. All the low levels but one were associated with serum potassium levels of 3.0 milliequiv. per liter or less.

Serum magnesium levels were done in 8 patients. Seven had normal values, whereas 1 had an elevated value.

Serum protein concentrations were determined on all patients. All showed a fall postoperatively, and all but 7 reached levels below normal. The maximum fall usually coincided with maximum hypopotassemia, and restoration of the serum protein level followed administration of potassium chloride alone. This is well illustrated in Figures 4 and 6.

Erythrocyte potassium concentrations determined before and after operation in 5 patients (Table 2) showed slight to moderate falls in each of 4 cases in which serum potassium levels below 4.0 milliequiv. per liter were encountered. Three of these cases demonstrated simultaneous rises in erythrocyte sodium. A fifth patient, in whom the serum potassium level was still normal at the time of the determination, showed no significant change in the erythrocyte concentration of either ion.

The symptoms and signs exhibited by the 32 patients are listed in Table 3. Although lethargy, apathy and depression were prominent in over half the patients, in only 4 did confusion, disorientation, delirium or hallucinosis occur. Nervousness, irritability and apprehension were conspicuous in 7 patients. Muscular twitching and tetany appeared in 3 (described above). Muscular weakness, often of a marked degree, was seen in 13 patients, but no complete paralysis was observed. One of these patients exhibited shallow, infrequent respirations, but none showed respiratory paralysis. Abdominal distention and cramps occurred in 19 patients. Fifteen had anorexia, nausea or vomiting, in spite of the fact that oral feedings were being withheld. Six patients had x-ray evidence of intestinal obstruction or paralytic ileus; a seventh, who was not given an x-ray examination, had a silent abdomen. Irregularities of the pulse due to extrasystoles were noted in 5 patients. Dependent edema developed coincidentally with potassium deficit in 9. Except for a fall in serum protein concentration there was no obvious clinical explanation for its appearance.

Administration of potassium chloride was followed with few exceptions by prompt and sometimes striking improvement in mental attitude, muscular strength, appetite, bowel function and cardiac rhythm, and by disappearance of edema. This is well illustrated in the cases reported above.

Electrocardiographic tracings were done on only 26 patients at the height of potassium deficit. Decreased amplitude of the T waves was observed in all but 3. In many cases the T waves were completely flat in one or more leads. Depressed ST segments occurred in 19 patients and were often most conspicuous in the precordial leads. Prolongation of the QT interval was found in 7 patients. Frequent ventricular premature beats were found in 2. In 1 patient (Case 17) they appeared suddenly on the sixth postoperative day in association with a serum potassium level of 2.1 milliequiv. per liter and were so numerous as to suggest imminent ventricular fibrillation. An auriculoventricular nodal rhythm and slurred QRS were each seen once. One patient had electrocardiographic evidence of myocardial infarction, several weeks preoperatively and again on the day of operation, which may have obscured changes due to potassium deficit. All the electrocardiographic abnormalities, except those due to infarction, disappeared on administration of potassium chloride. The rate of disappearance in general paralleled the restoration of the serum potassium level and occurred within twenty-four hours in some cases (Case 2) or was delayed in others (Case 1). The electrocardiogram in Case 3, however, returned to normal in spite of a persistently low but slowly rising serum potassium level.

(To be concluded)

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MYASTHENIA GRAVIS: A CLINICAL AND PATHOLOGICAL STUDY OF A CASE ASSOCIATED WITH A PRIMARY MEDIASTINAL THYMOMA AND A SOLITARY SECONDARY INTRAPULMONARY THYMOMA*

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THE tumor of the thymus occurring in about a sixth of the patients presenting the symptoms of myasthenia gravis is usually encapsulated and slowly growing and is generally regarded as a benign neoplasm. It has been called a thymoma.[1] Ten per cent or less of such thymomas encroach upon and extend by continuity into the adjacent pleura, lungs, pericardium or superior vena cava. Separate, discrete, secondary deposits of such thymomas occasionally found at a distance on the pleura have been interpreted as implants and not as true metastases.[1, 2] Separate, discrete, secondary metastases from such thymomas in other organs have not been previously reported. None of the reported highly malignant widely metastasizing tumors arising from the thymus have been associated with the symptoms of myasthenia gravis.[3] The details of a case of myasthenia gravis associated with a large, primary, invasive mediastinal thymoma and also a single separate, discrete, secondary intrapulmonary thymoma nodule are the subject of this report.

CASE REPORT

In June, 1944, E. H., (B. I. H. M 4921), a 33-year-old woman, experienced a sore throat, difficulty in swallowing and a nasal twang in her voice for several days. Fluoroscopy of the chest revealed a mass in the left upper mediastinal region. One month later, after radiation treatment totaling 1200 r, a roentgenogram showed decrease in size of the mass. In October, the mass appeared to be larger on x-ray examination, and in December additional treatments totaling 3600 r resulted in almost complete disappearance. Subsequent recurrences of the mass in August, 1945, and January, 1946, were again treated with radiation in similar amounts. Difficulty in swallowing and a nasal twang in her voice recurred about every 3 or 4 months, apparently precipitated or aggravated by fatigue or emotional upset; these complaints lasted several days to 1 week. The diagnosis of myasthenia gravis was made in April, 1946. In early January, 1947, a mild respiratory infection was associated with recurrence of the nasal twang in her voice, and the development of ptosis of the right upper eyelid and diplopia. She was unable to rub her lips together. Within 10 minutes of a subcutaneous injection of 1.0 mg. of Prostigmine methysulfate her voice improved, and paresis of the eyelid and the diplopia disappeared. Prostigmine bromide, 15 mg. every 2 hours for 6 or 7 doses, was prescribed orally. She did well until March, 1947, when after an attack of gastroenteritis, the diplopia recurred and persisted in spite of increased dosage of Prostigmine of 60 mg. every 2 hours for 6 or 7 doses. Troublesome abdominal cramps were partially relieved by atropine. A chest film revealed no change in the size of the mediastinal tumor. Ephedrine sulfate, 24 mg., proved helpful. She continued to be comfortable on a daily dosage schedule of 60 mg. of Prostigmine every 2 hours for 8 doses, and a 24-mg. ephedrine tablet on awakening and at noon. In August, the dosage of Prostigmine was reduced to 30 mg. every 2 hours for 6 or 7 doses, and the ephedrine was discontinued. Bell's palsy developed in September and lasted 2 weeks. In October, after an emotional upset, diplopia and dysphagia recurred. Increase in the dosage of Prostigmine afforded only partial relief. In December chest films showed the mediastinal mass to be unchanged in size since the films taken the previous May; an additional homogeneous area of increased density obscured the apex of the left lung and extended anteriorly down to the level of the second rib.

On December 23, because of difficulty in controlling the symptoms, an exploratory thoracotomy was performed.

The tumor was an enormous one and consisted of two parts, one lying in the mediastinum embracing the ascending aorta and extending to the anterior wall of the chest and from the level of the heart up almost to the base of the neck. This portion of the tumor was dense and firm and could not be dissected free from the aorta or any of the adjacent tissues to which it was adherent. Arising from this portion and extending upward and posteriorly into the left side of the chest,

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growing through the mediastinal pleural reflection and directly into the adjacent surface of the upper lobe of the lung was a very soft, vascular, apparently rapidly growing extension of the tumor. The tissues here were so soft and friable that they appeared to be almost necrotic. Some of the tumor lying just above the aortic arch was so friable that it actually came away on the finger when it was touched very lightly. There was absolutely no possibility of removing this tumor, either in part or as a whole, and nothing could be done except to obtain pieces of it for biopsy purposes. Specimens were taken from various portions of the tumor.*

Microscopical examination showed that the biopsy of the firmer portion of the tumor was predominantly epithelial, with a scattering of lymphocytes. The biopsies from the grossly softer areas comprised predominantly lymphocytes, with a few scattered epithelial cells. In both areas an occasional mitosis was seen in the epithelial cells between the lymphocytes. No evidence of normal thymus or Hassall's corpuscles was observed. The diagnosis was thymoma.[1]

Postoperatively the patient received a long course of x-ray treatments, and the recurrent myasthenic symptoms were controlled with slightly less Prostigmine. In February, 1948,

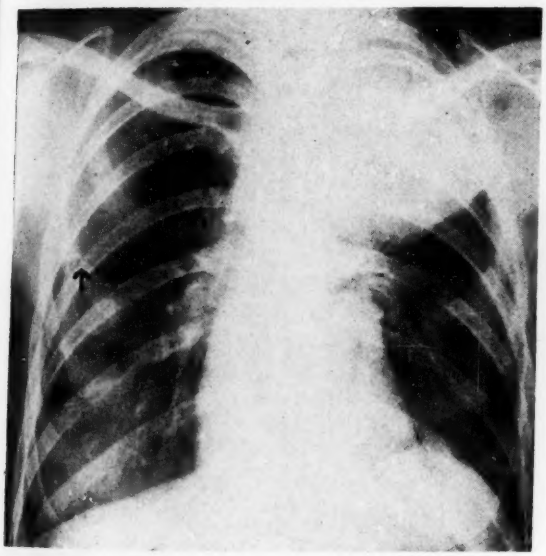

FIGURE 1. *Chest Film, Showing the Mediastinal Tumor, Extension to the Upper Lobe of the Left Lung and the Two Nodules in the Right Lung, the Upper Triangular-Shaped Hemorrhagic Infarct and the Lower Discrete, Secondary Thymoma Nodule.*

cough, fever, severe orthopnea, cyanosis and inability to expectorate the abundant loose bronchial secretions developed. After a subcutaneous injection of 2.0 mg. of Prostigmine, the symptoms improved dramatically. Chest films showed no change from the preoperative films taken in December, 1947. On penicillin and oral and subcutaneous administration of Prostigmine, the patient did well. At the suggestion of Dr. Samuel L. Gargill testosterone therapy was instituted. Intramuscular injections of 50 mg. of testosterone propionate were given daily for 10 days, followed by injections of 25 mg. three times a week for 3 weeks. In March and April, 1948, diplopia recurred. In addition to the oral dose of Prostigmine, 45 mg. every 2 hours for 7 doses, ephedrine sulfate, 24 mg. twice daily, and methyl testosterone, 10 mg. once daily, were prescribed. Abdominal cramps and frequent bowel movements were troublesome for a time. In July and August the dose of Prostigmine was reduced to 30 mg. every 2 hours for 6 or 7 doses; the ephedrine was discontinued, but the 10 mg. of methyl testosterone daily was continued.

The patient did well until February, 1949, when, a few days after an ultraviolet treatment to her face and upper anterior portion of the chest at a beauty parlor slight difficulty in swallowing, swelling of the face, eyelids, neck, right upper extremity and right breast, distention of the neck veins and a pea-sized, slightly tender lymph node deep in the right Kernig isthmus developed. A chest film revealed no further changes in the mediastinal and left-upper-lung shadows. However, for the first time two areas of increased density in the right lung were noted. These were both interpreted as metastatic tumor nodules (Fig. 1).†

In March the patient was again hospitalized because of a respiratory infection with difficulty in raising sputum and

FIGURE 2. *Section of the Lower Lobe of the Right Lung Removed at Autopsy, Showing the Pleural Surface and the Intrapulmonary Separate, Discrete Secondary Thymoma Nodule (x 30).*

the development of severe orthopnea and cyanosis. In spite of intensive therapy consisting of frequent massive doses of subcutaneously administered Prostigmine, tracheal intubation, postural drainage, oxygen therapy, penicillin and intracardiac injections of epinephrine, the patient died shortly after admission.

Autopsy (A-49-19), performed 3½ hours after death, revealed a firm tumor mass in the anterior and middle portions of the mediastinum. It extended to the apex of the left lung and was adherent to the second and third left costochondral junctions, and in its posterior aspect overlaid the great vessels. The mass encompassed the pulmonary and left subclavian arteries and compressed the lower portion of the superior vena cava. It also extended directly into the pericardial cavity around the pulmonary artery. On section the tumor was grayish white, with many necrotic areas.

The left pleural cavity was obliterated by firm adhesions. The upper lobe of the left lung was largely replaced by large, thick-walled cavities filled with yellowish puriform necrotic material. The main bronchus to the left upper lobe and its branches ended abruptly and extended into the center of a necrotic cavity. The bronchi to the left lower lobe were filled with thick, tenacious, glistening mucus. The mucosa

*We are indebted to Dr. Richard H. Sweet for permission to use these data.

†We are indebted to Dr. Felix Fleischner, director of the X-Ray Department, Beth Israel Hospital, for the reproduction of the x-ray film of the chest.

of the bronchi showed slight congestion. The lower lobe of the left lung was otherwise normal.

The right pleural cavity showed a few delicate fibrous adhesions over the lower lobe but no exudate. In the upper portion of the lower lobe of the right lung was a firm, white, spherical mass measuring 2 cm. in diameter. This nodule did not abut on the pleural surface but lay within the parenchyma of the lung (Fig. 2). In the posterior aspect of the upper lobe of the right lung was a firm triangular area, which measured 3 by 2 cm. and on cut surface was beefy red. Otherwise, the right lung and the remaining organs revealed nothing of note.

Microscopical examination of the striated muscle demonstrated "lymphorrhage" infiltration characteristic of myasthenia gravis. The firm triangle mass in the upper lobe of the right lung was found to be a hemorrhagic infarct on microscopical examination.

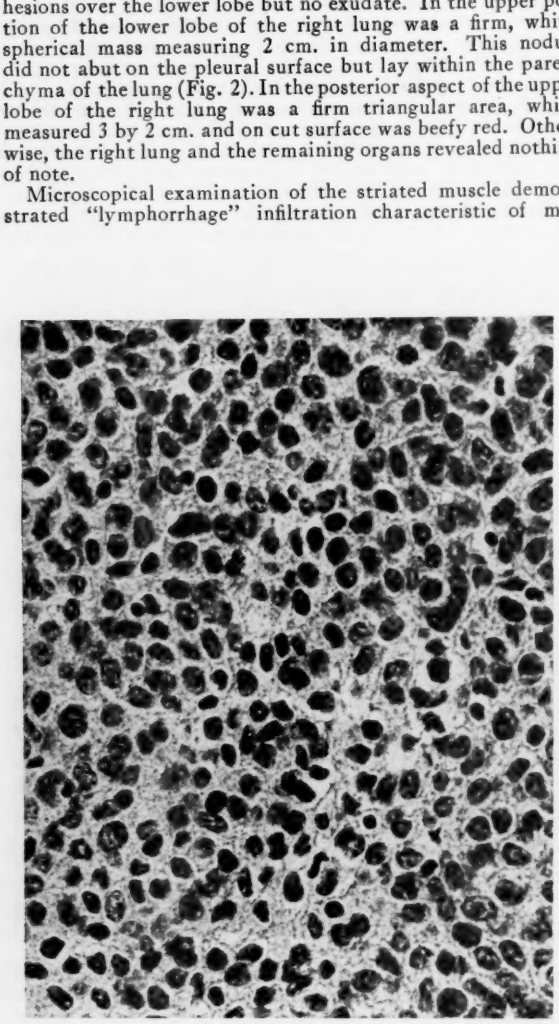

FIGURE 3. *Section of the Mediastinal Thymoma Removed at Autopsy, Showing the Predominance of Epithelial Cells with a Scattering of Lymphocytes (x 500).*

Microscopical sections of the mediastinal thymoma, its extensions and the separate discrete thymoma in the right lung showed a variable picture. Many areas disclosed much necrosis, and other large zones were composed of dense fibrous tissue. In the better preserved areas the usual considerable variability in the cell types characteristic of thymomas was observed. In the main mass of the original mediastinal thymoma the picture was predominantly epithelial, with a scattering of lymphocytes (Fig. 3) as noted earlier by Castleman and Norris[1] on the biopsy of this tumor (Fig. 16 in their study). The portion extending into the pericardial cavity was predominantly lymphocytic (Fig. 4). This variant had also been found in some areas of the original biopsy (Fig. 17 in the paper of Castleman and Norris). In the separate, discrete, secondary thymoma in the lower lobe of the right lung the distribution of the epithelial and lymphocytic elements was approximately equal (Fig. 5). In this nodule, masses of actively growing tumor were found in continuity both inside and outside a bronchial branch (Fig. 6 and 7). Occasional mitoses were present in the epithelial cells both in the original mediastinal tumor and in the nodule in the right lung.

Discussion

The patient under discussion presented the typical symptomatology and clinical course of myasthenia gravis.[4] During the first two and a half years of her five-year illness, dysphagia and dysarthria occurred infrequently and were related to fatigue, emotional upsets or respiratory infections. Five years before death a mediastinal mass was discovered on x-ray examination and was treated by radiation. During the last two and a half years of the patient's life, the myasthenic symptoms were more severe, and orally administered Prostigmine was continually necessary to control them. Myasthenic crises developed on two occasions in association with respiratory infections. The first crisis was successfully treated, but the second precipitated the patient's death. A superior-vena-cava syndrome of brief duration developed shortly before death and appeared to have been occasioned by an ultraviolet treatment.

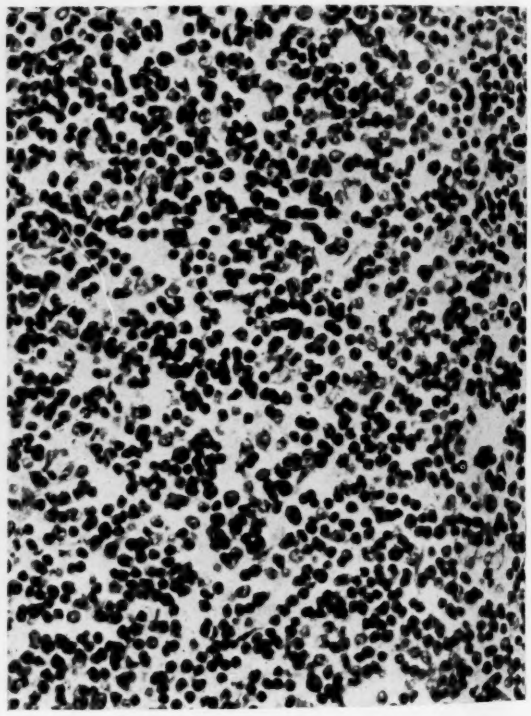

FIGURE 4. *Section of Extension Into the Pericardial Cavity of the Mediastinal Thymoma Removed at Autopsy, Showing the Predominance of Lymphocytes and a Scattering of Epithelial Cells (x 300).*

Repeated x-ray examinations of the chest revealed the mediastinal shadow interpreted as a

tumor at the onset of the illness, temporary changes in its size after x-radiation for two and a half years, its extension to the apex of the left lung prior to the exploratory operation and, finally, shortly before death the appearance of two new shadows suggestive of metastases in the right lung. The operative and autopsy findings confirmed the x-ray observations with one exception: one of the shadows in the right lung proved to be a pulmonary infarct. The radiation neither permanently prevented the spread of the mediastinal tumor nor exerted any striking effect upon the myasthenic symptoms.

The operative findings and biopsy data on this patient were included by Castleman and Norris[1]

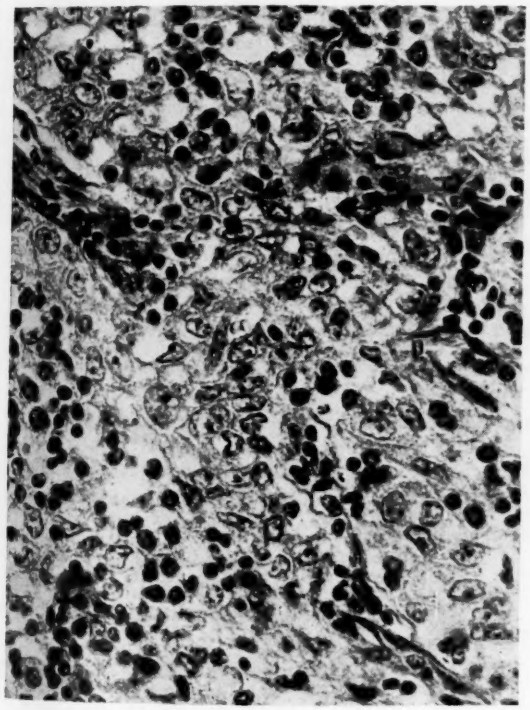

FIGURE 5. *Section of Separate, Discrete, Secondary Thymoma Nodule in the Right Lung Removed at Autopsy, Showing Approximately Equal Distribution of Epithelial Cells and Lymphocytes (x 500).*

(Case 4) in their recent monograph on myasthenia gravis. At that time the mediastinal neoplasm had already extended to the overlying pleura and adjacent parenchyma of the upper lobe of the left lung. It had a characteristically variable pattern in that some portions were predominantly epithelial and others predominantly lymphocytic. They considered it analogous to the other 9 thymomas they described. The histopathology of the mediastinal tumor and its direct extensions found at autopsy was comparable with the biopsy specimens. However, in the separate, discrete, secondary nodule in the right lung the epithelial and lymphocytic elements were approximately equally distributed, unlike any part of the primary tumor. This pattern

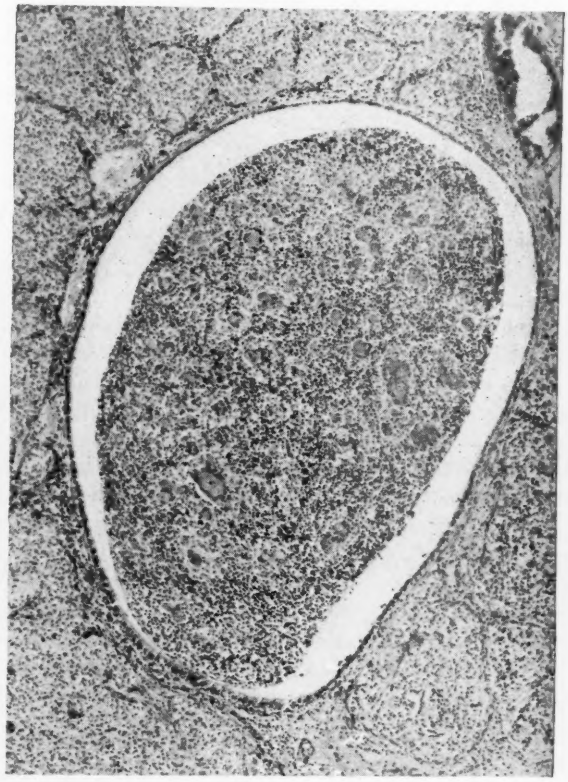

FIGURE 6. *Section of the Lower Lobe of the Right Lung Removed at Autopsy, Showing the Thymoma within an Intact Bronchus (x 66).*

was noted by Castleman and Norris[1] in other thymomas.

It is noteworthy that the original biopsy of the thymoma under discussion was the only one of the 10 thymomas described by Castleman and Norris[1] in which mitoses were found. They found mitoses in the epithelial elements of both the predominantly epithelial and the predominantly lymphocytic portions. In the tumor tissue obtained at autopsy, mitoses were present in the epithelial elements both in the mediastinal tumor and in the secondary, discrete pulmonary nodule. They were absent in such portions of the tumor obtained at autopsy as were predominantly lymphocytic.

One can speculate about the mode of transport of the neoplastic cells from the primary mediastinal

tumor (or its extensions) to the right lung. This may have been by way of the more usual paths — that is, the blood stream (superior vena cava) or lymphatic stream (mediastinal lymph nodes) — or by the more unusual air stream (bronchial lumen). In support of the latter hypothesis is the necrotic erosion into a large bronchus of the extension of the primary tumor into the left lung. In the solitary secondary nodule in the right lung, the continuity of masses of actively growing tumor within and about a bronchial branch also favors this concept.

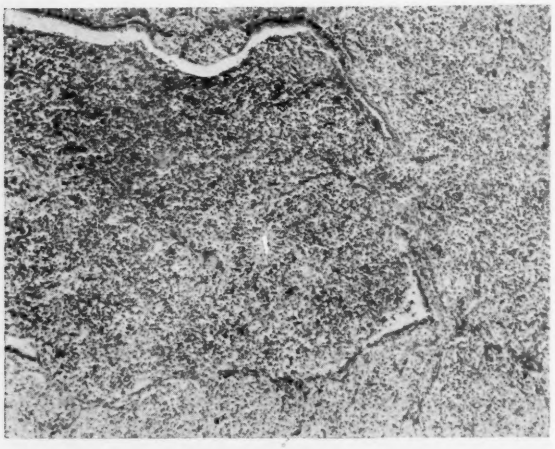

FIGURE 7. *Section of the Lower Lobe of the Right Lung Removed at Autopsy, Showing the Thymoma in Continuity Inside and Outside a Bronchial Lumen (x 66).*

Careful search of the literature has failed to reveal a similar case of myasthenia gravis associated with a mediastinal thymoma and a separate, discrete, secondary tumor nodule in the lung.

SUMMARY

The clinical observations and post-mortem findings of a unique case of myasthenia gravis are described. In this patient with a large primary invasive mediastinal thymoma, a separate, discrete, secondary intrapulmonary nodule of thymoma was found at autopsy. Careful search of the literature has failed to reveal a similar case.

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NEWER OCCUPATIONAL DISEASES*

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MEMBERS of the staff of the Division of Occupational Hygiene have attempted to keep members of the Massachusetts Medical Society informed regarding current problems in occupational hygiene. Such attempts have included summaries of work in the field of industrial hygiene[1-4] and reports regarding anthrax in Massachusetts[5, 6] and particularly the appearances of new clinical syndromes in workers exposed to beryllium compounds.[7] This entity has received nationwide interest because of the varied uses of beryllium and its compounds and because various types of pneumonitis have been experienced almost everywhere this element or its compounds have been used. It is hoped that the peak of cases in Massachusetts has been reached, particularly because lamp manufacturers are no longer using beryllium,[8] a change advocated by the Division of Occupational Hygiene to the Medical Advisory Committee on Beryllium in December, 1947.[9]

Atmospheric pollution has succeeded beryllium in interest among industrial hygienists, although, here again, beryllium is an offender. This subject has received increasing attention since the "Donora disaster,"[10] and articles[11] too numerous to mention have been prepared on the subject. This division has co-operated with the Division of Sanitary Engineering of the Massachusetts Department of Public Health in studying such problems in Massachusetts.

Since the war, there has been amazing progress in the field of agriculture, particularly in the development of new economic poisons. It is believed that the public is fully informed regarding the abilities of DDT, but it is doubted that many people are informed concerning other insecticides that are far more toxic to insects and, unfortunately, also to human beings. Formerly, lead, arsenic, copper, sulfur and fluorides were largely used, but they have given way to the more potent organic compounds. In 1947 almost 34,000 tons of these materials were produced in the United States. This increased production is of concern to the industrial hygienist and is becoming of concern to the medical practitioner. Although the exposure of workers to these substances can be effectively kept at a minimum in large plants devoted to their production, a problem exists in small establishments engaged in mixing and blending the concentrated insecticides and in packaging

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the resultant product. The problem extends from these remixing plants through agencies distributing and selling them right on down to the ultimate user, generally an agricultural laborer, who may have little knowledge of the potential hazard to his health from such materials and only a rudimentary concept of how to protect himself against the hazard.

The success that the use of DDT achieved as an insecticide stimulated research in the field of organic insecticides, with the result that several new products have been marketed prior to the accumulation of sufficient data regarding their toxicity to warm-blooded animals. Space does not permit reference to the data concerning the toxicity of these various insecticides that appear in a gradually increasing literature on the subject.[12, 13] Whereas chlorinated organic compounds such as DDT, chlordane, benzene hexachloride (gammexane) and chlorinated camphene have been used with some adverse effects, most industrial hygienists are acutely aware of the problems presented by the use of the organic phosphates such as hexaethyltetraphosphate (HETP), 0, 0-diethyl, O-p-nitrophenylthiophosphate (Parathion) and tetraethylpyrophosphate (TEPP) because these substances have been proved to be more toxic to human beings and several deaths have been reported as a result of their use. Parathion has, perhaps, received the greatest attention, and two of the concerns manufacturing it have had extensive animal experiments performed to evaluate the toxicity of this compound. They have also studied the cases of human poisoning that have been reported. Both companies issue literature[14, 15] emphasizing the hazardous nature of the material and describing in detail protective measures and medical control. In addition, all containers are provided with adequate warning labels.

Dr. D. O. Hamblin has described the symptoms of Parathion poisoning.[16] The initial complaint is giddiness, usually accompanied by pin-point pupils. Within two to eight hours of the initial complaint, the following symptoms may appear: nausea, abdominal cramps, vomiting, diarrhea, muscular twitching, coma, convulsions and death. Because of the muscarine-like action of Parathion — that is, stimulation of the parasympathetic nervous system — atropine is a definite antidote. There is no question that placing of the patient in an oxygen tent immediately upon the first signs of possible pulmonary edema is indicated and of great benefit. Since the compound has a low vapor pressure and hence, under ordinary room temperatures vapor concentrations would be low, thus reducing the vapor inhalation hazard, it is probable that acute illness is more apt to follow an exposure involving skin absorption. The use of protective clothing and personal respiratory protection is advocated for protection of agricultural workers and the provision of adequate local exhaust ventilation systems additionally for industrial workers.[17, 18] Recently, two leading manufacturers of personal respiratory protective devices have produced gas masks and respirators designed to protect the wearer against Parathion dusts and vapors.

Two cases reported by Hamblin[16] are of interest. In the first, a foreman was sprayed by the liquid technical grade of Parathion, approximately 95 per cent, and simultaneously a fellow employee was similarly sprayed. The foreman insisted that the other worker change clothes and thoroughly cleanse his skin. This was done, and the worker suffered no adverse effects. The foreman himself, however, neglected one or the other of these procedures. He was splashed at 3 a.m. and felt well until 11 a.m., when he experienced nausea, vomiting, cramps and diarrhea, and a marked constriction of the pupils. He did not seek medical attention until 6:30 p.m. of that day, when he was admitted to a hospital. He manifested some fibrillary twitching of the voluntary muscles and some moist rales in his lung fields, indicating early pulmonary edema. He was given 0.6 mg. (1/100 gr.) of atropine subcutaneously, with temporary relief. Shortly thereafter, the pulmonary edema became so marked that he was placed in an oxygen tent; he soon became deeply comatose and, after a series of convulsions, died at 12:20 a.m. Post-mortem examination revealed an acute pneumonitis and marked cerebral edema.

The second case was that of a girl who was engaged in repackaging damaged bags of 15 per cent wettable powder. She worked at this task for several hours, wearing a respirator, but no ventilation was provided for the operation. After a few hours, she complained of dizziness, and the part-time plant physician examined her. He observed pin-point pupils and a greenish pallor, accompanied by a cyanotic appearance of the skin. He immediately administered 0.6 mg. (1/100 gr.) of atropine subcutaneously, and she was sufficiently relieved to go home alone by streetcar. About two and a half hours later, the physician was summoned because her parents observed her to be extremely ill. The physician stated that the girl was in the most extreme coma he had ever seen and he could elicit no reflexes whatsoever. In addition, she was suffering from the most marked pulmonary edema he had ever witnessed. He drained about 8 ounces of a frothy fluid from her lungs and then rushed her to a hospital, where she was placed under an oxygen tent and given 0.6 mg. (1/100 gr.) of atropine subcutaneously. This was repeated every hour while the patient remained in the oxygen tent. About 1200 cc. of a bloody fluid was obtained by stomach drainage. The patient became incontinent of urine and feces shortly thereafter. Each time atropine was administered there were short-lived evidences of improvement, these improved periods

being succeeded by convulsive movements and coma. After midnight she improved, and on the following morning she appeared quite normal, except for marked constriction of the pupils. On the following afternoon the pupils had returned to normal, and on the next morning she was entirely well.

The Division of Occupational Hygiene, the Division of Sanitary Engineering and the Division of Food and Drugs of the Department of Public Health, the Division of Plant Pest Control of the Department of Agriculture and the Field Experiment Station of the University of Massachusetts have held meetings concerning the use of Parathion. Parathion is being recommended as an alternative spray for apples, peaches and pears on the commercial schedules put out by the University of Massachusetts. The precautions in its use are being emphasized. It does not appear on the "home schedules." Since five times as much TEPP was used in Massachusetts in 1949, with few reported adverse effects and no fatal cases, the agriculturists expect no trouble from Parathion, since it is only half as toxic. However, it is believed that Massachusetts physicians should be aware of this type of poisoning and should know that atropine is the recommended antidote. Possibility of delayed pulmonary edema should also be considered.

Another disease that is relatively new to Massachusetts is coccidioidomycosis. Within the last six months, a worker employed in a wool-scouring plant in Massachusetts but residing in Rhode Island was fatally afflicted, the diagnosis being confirmed by pathological post-mortem studies.

The worker had been employed as a wool sorter in the plant for approximately three years prior to his illness and had previously been employed in various other wool-scouring plants for an appreciable but undetermined period. He had been born in Iowa, where he lived until the age of sixteen years, when he moved to Rhode Island, residing in that state until his death. He had never visited the West Coast or the Southwest, nor had he been in the armed forces. He had no hobbies or part-time employment. His widow stated that he had never been seriously ill.

The room in which this man performed wool sorting was large, well lighted and well ventilated. Sorting was done on a conveying system, utilizing two two-unit machines and requiring the services of 24 men. Sixteen of the men broke open the wool, and the others sorted it. In addition, there were 10 workers performing related tasks in the room. After being sorted, the wool was transported to another room, where 2 workers did additional sorting. Thence it was conveyed to the scouring vats. Since wool sorting is a specialized occupation, the worker-patient's only duty was that of sorting wool. There did not appear to be any great dust concentration in this room, probably because of the necessity of reducing such concentrations because of the potential anthrax hazard.

The wool scoured by this company has its origin in many parts of the world. The patient had come in contact with wool from Uruguay, Texas, West Virginia, Wyoming, Australia, Ohio, Montana, Utah, North Dakota, Oregon, Brazil, Idaho and California for several months preceding his illness. He had sorted wool from California for the periods between August 7 and 21 and September 11 and 18. It was learned that wool from California and other areas where the terrain is flat and dusty might be and usually was very dirty, dusty and possibly sandy.

The progress of the patient's illness was obtained from his widow, the plant medical records, his physician and the hospital records. Three years prior to this episode, the entire plant population was given routine x-ray examinations, with negative results, except for 1 known tuberculous worker. The patient and his family had had chest x-ray films taken, with negative results, in Providence during a survey by the Public Health Service in January, 1949. The patient was absent from work from October 11 to 14, 1949, with what was described as a severe cold, at which time he complained of vague aches and pains throughout his body. He returned to work on October 17, and remained until October 25, at which time he was forced to be absent because of a similar illness. Plant medical records show that he had rarely reported to the first-aid room, the last visit having been made on October 9, 1947, for a minor injury. During his absence from work, no other employee was absent for a similar reason.

He was first seen by his physician on October 21, when he complained of pain in the left shoulder and right ankle and elevation in temperature. Under supportive treatment these symptoms diminished, and he was able to work for a few days, after which he complained of pain in both feet and an aching pain in the back and left shoulder. Fever was again present, and after three days, when his symptoms had increased, he was hospitalized. At this time he was still in pain and suffered from loss of appetite. Physical examination revealed only elevation in temperature, coarse rales in both sides of the chest without consolidation and a redness and swelling on the inner surface of both ankles. During the hospital stay, the course of the illness was continually downhill, and x-ray study of the chest revealed a nodular miliary-appearing infiltration uniformly scattered throughout both lung fields. No pleural effusion was evident, and the heart and aorta appeared normal. Diagnoses considered at that time were rheumatic fever, miliary tuberculosis and erythema nodosum. Laboratory studies during the hospital stay showed a + test for albumin in the urine and a decrease in hemoglobin and red-cell count. Cultures of the blood on

two occasions and of the skin lesions on one occasion demonstrated fungous growth, but the fungi could not be identified. Treatment consisted of dihydrostreptomycin and a saturated solution of potassium iodide. The patient lost weight markedly, became worse clinically and was delirious and disoriented toward the end. He died on November 12, 1949.

At autopsy, the pathological diagnosis was disseminated coccidioidomycosis, with involvement of both lungs, heart, peritoneum, liver, spleen, pancreas, kidneys, bone marrow and skin. Gross examination of these organs revealed numerous whitish discrete and confluent ovoid deposits up to 1 mm. in size. Granulomatous reactions could be seen microscopically, with numerous round or ovoid double-walled spherules in the granulomatous regions. The latter varied from 10 to 60 microns in diameter and had granular protoplasm, which consisted of numerous round and oval endospores in the large spherules. Rupture of the capsule, with liberation of endospores, was noted in several instances.

There can be no doubt that the patient died of disseminated coccidioidomycosis. It strongly appears that he had contracted the disease as a result of his occupation. It is hoped that x-ray film of the chests of his fellow workers will be taken and also that skin coccidiodin tests will be done to determine if other workers have positive reactions. Culture of the organism from the wool or dust might be helpful, but in the light of the recent report by Looney and Stein,[19] mycologists are reluctant to attempt this. However, there is a possibility that a culture will be done in California.

Another disease that has recently been investigated by the Division is that occasioned by the exposure of workers to tetryl dust. The dermatitis occasioned by exposure of workers to this explosive has been well known since World War I.[20] However, experience during the recent war culminating in illness after a period of delay has recently been described by Hardy and Maloof.[21] From post-mortem study of 1 case and a clinical study of 2, they conclude that it is possible that heavy tetryl exposure resulted in cirrhosis of the liver, with failure of that organ and death. A period of two or three years elapsed between cessation of exposure and death. Because of this delay, and the fact that munitions workers ceased to come under close medical control after the war, it is possible that other cases have been undiscovered. Since most munitions workers were exposed only to minimal concentrations, and since there was a high turnover among these workers, it is possible that more systemic poisoning has not been experienced because the workers were not exposed to sufficiently high concentrations for protracted lengths of time. The fact that of 11 workers in a small plant 3 suffered from cirrhosis of the liver, resulting in permanent disability for 1 and death for the others, indicates that tetryl should be considered a systemic toxin.

Another occupational disease hazard that, although not new, has recently received nationwide attention is that occasioned by the use of shoe-fitting fluoroscopes. Studies have been made in Detroit, New York City and Cleveland, as well as some of the states, including Massachusetts, of the hazards to employees operating these machines and to the public. One study[22] indicated that the chief hazard is occasioned by the use of old machines, which were not properly constructed or protected, and by the fact that the persons operating these machines have not been properly trained in the use of x-ray equipment and do not appreciate the potential dangers from the use of such equipment.

Some of the concerns that repair these machines have indicated that they can be adequately shielded to reduce the scatter radiation to a minimum. It is also possible to reduce the intensity of x-rays to the foot of the person using the machine by reducing the current utilized by the tube, by providing a protected 1-mm.-thick aluminum filter and by utilizing a high-quality fluorescent screen. If, under the above conditions, the timing mechanism is properly set to limit the exposure to five seconds, during which an adequate fitting can be made, the dose in the foot chamber will be 1 r.

Currently, the Code Committee of the American Conference of Governmental Industrial Hygienists is considering the adoption of a uniform code for shoe-fitting machines. It is anticipated that this code will be published in August. In the interest of having uniform regulations throughout the country, the Division is awaiting the promulgation of this code before taking any regulatory action.

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THE ABUSE OF BED REST IN THE TREATMENT OF MYOCARDIAL INFARCTION*

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IN MEDICINE the ritualistic following of unproved traditional procedures is a common fault. Although it is never sound to desert the established practice because it is unproved, it is always important to review periodically the evidence bearing upon it. This is especially true when the treatment involves conflicts with the natural, perhaps instinctive, tendencies of the patient. For many years the physician rigidly restricted the fluid intake of edematous persons, with no voice but the patient's raised in protest. Surgical and obstetric patients were likewise kept at prolonged postoperative or postpartum bed rest until critical thought, and perhaps the shortage of beds, stimulated the re-examination of the evidence.

There is no statistical evidence that bed rest, or even markedly restricted activity over a prolonged period, advantageously affects either the course or the later sequelae of myocardial infarction. No controlled series of cases has been reported. Yet bed rest has long been the *sine qua non* in the treatment of myocardial infarction, and periods of four weeks or more as a minimum are advised by most textbooks and authorities.[1-5] Harrison,[6] Dock[7, 8] and a few others[9, 10] have dissented. Levine[11] appears to concur with this to some extent, especially in mild cases. Blumgart and his associates,[12] however, have recently spoken out against this trend. Ever since Herrick described the condition clinically in 1912 and 1916, prolonged bed rest has been widely advocated, but before that time it was evidently not so widely used in heart disease or angina pectoris. Two famous physicians, Hunter and MacKenzie, lived actively productive lives for years after what appear to have been myocardial infarcts, despite the fact that prolonged immobilization was not then practiced.[6] However, since the clinical diagnosis was not recognized, historical evidence on unrested myocardial infarction does not exist.

The important advantages ascribed to bed rest are the avoidance of cerebral anoxia during shock, prevention of sudden death and preservation of myocardial function. The first is an immediate protection to the patient whose circulatory collapse briefly necessitates a recumbent or head-down position.

The problem of sudden death is a more complex matter and may be broken down into several categories. The first is that of rupture of the myocardium. Concerning this, it is believed that rupture of the heart apparently does occur frequently at the time that some exertion has just taken place and that large, mushy areas of necrosis have been noted for as long as five to six weeks after infarction. However, cases of rupture usually occur during the first two weeks and are relatively uncommon thereafter.[13] In this regard it has been shown that, "... histologically, much of the necrotic muscle has been replaced by connective tissue by the end of the first fortnight."[14] After this time healing continues and is not complete until five to eight weeks, depending upon the size of the infarction and the adequacy of the remaining circulation. There are occasional hearts that apparently have shown no evidence of healing although examination may take place three to five weeks after onset. There are several points that should be further considered. In the first place, is it not probable that there is a minimal area of necrosis that must be present before rupture can occur? Secondly, is there a type of infarction in which the area of necrosis may be excessively large or the remaining circulation totally inadequate where healing can never take place? It has been demonstrated pathologically in a small series of ruptured hearts[15] that necrosis without evidence of healing was the sole type of lesion. Is it not possible that these patients could not have survived under any conditions, and that effort may only have determined the time of rupture? One cannot be certain whether the same type of pathologic pattern occurs in patients who survive. It does occur occasionally in those who die without rupture. The report of Jetter and White[16] concerning the high incidence of rupture of the myocardium in sudden, unexplained deaths of committed psychotic patients cannot be used as a simple

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answer to these questions. The selection of sudden deaths only impairs the value of this group for comparison with routine autopsies of patients dying in general hospitals of myocardial infarction. These patients presumably did not take even reasonable precautions, and may have been excited both physically and mentally during the immediate post-infarction period; in 14 of their 16 cases the rupture evidently occurred, as judged by pathological criteria, during the first two weeks after onset, a period in which few would advocate unrestricted activity.

Another cause of sudden death is the abrupt occurrence of arrhythmias. This may be a considerable number, and in most reports sudden deaths without other demonstrable cause are attributed to this. This is by nature a group that cannot be studied systematically, and the physiologic cause of death is somewhat speculative. However, arrhythmias and premature beats are believed to arise from anoxic or injured myocardium, and any procedure that could increase the degree of anoxia might produce an arrhythmia. These, however, are prone to occur even earlier than rupture,[17] or at least early in the course.[18]

The capacity for function of the heart after recovery depends largely upon the mass of effectively contractile heart muscle that remains. The area of the scar, referred to by many authors, is a negative quantity of less importance. If the scar is aneurysmal, wasting the efforts of the ventricle by its elasticity, it is presumably disadvantageous. However, that aneurysm per se does not alter the prognosis has long been recognized. The possibility that aneurysm production is favored by early activity is suggested by the work of Sutton and Davis.[19] These authors exercised a small series of dogs on treadmills in the early days after experimental myocardial infarction. This widely quoted work involved only 5 dogs, in 1 of which a possible aneurysm appeared — presumably due to exercise begun on the third day after the infarction. This series need not be considered in relation to the clinical problems because the forced exercise is foreign to anything in the treatment of human cases and the group is so small as to be statistically worthless. The influence of this single experiment on opinion concerning treatment has been considerably wider than the work warrants. The study of Thomas and Harrison[20] in rats, both restrained and allowed normal activity, indicate opposite results in that the "active" rats did better. The analogy between restraint and bed rest, however, is so questionable as to make the applicability of this experiment to human beings dubious. No series relating the incidence of ventricular aneurysm to the type of treatment has appeared. Other evidence concerning the residual functional ability of the myocardium in the human being is by nature conjectural. Blumgart et al.[21] have shown that collateral circulation develops only by demand of insufficient blood supply and not with age per se. That increasing activity during part of the healing phase would tend to produce a collateral circulation more adequate for normal function is not an untenable point of view.

The time relations between the onset of myocardial infarction and death have not been adequately studied. Most reviews concerning the immediate prognosis of myocardial infarction lump all deaths in the first four to six weeks in one group. Figures show[22] that deaths decrease in step-like fashion during the first six weeks if divided into two-week groups. What would be even more interesting to know is the portion of patients dying after the fourteenth day who die unexpectedly while apparently doing well. Further clinical study would perhaps confirm the suspicion that the prognosis becomes increasingly predictable. Just how many patients who survive past the fourteenth day and who are doing well at that time, subsequently die is an unknown but important fact.

Selzer[17] has briefly studied this problem and notes that deaths from complications such as pulmonary embolism and pneumonia occur later than deaths from circulatory failure and arrhythmia.

The subject of time in relation to coronary occlusion should not be discussed without reference to Master's[23] studies showing that activity is not related to the onset of thrombosis. If prevention of a second thrombosis is part of the reason for prolonging inactivity or bed rest, his figures argue against the policy.

The disadvantages of recumbency are many. The circulation to the basilar part of the lungs is poor; atelectasis, hypostatic pneumonia and constipation are common. Levine[24] suggests that congestive failure may get worse in the recumbent position, and Harrison[25] considers the sitting position more favorable for patients with angina pectoris. The development of phlebothrombosis and subsequent embolization is much higher, and this fact should not be lost sight of even though Dicumarol has done much in preventing fatal emboli. Deitrick,[26] recently working with normal young human volunteers subjected to prolonged bed rest, found the exercise tolerance, as measured by the Master and Schneider tests, markedly decreased — requiring many weeks to return to normal. He noted many other disadvantages of prolonged bed rest, including abnormal nitrogen and calcium metabolism and deterioration in the mechanisms essential for adequate circulation in the erect position as indicated by an increased tendency to faint in tilt-table tests: "Experiments indicated that the legs were the principal site of changes responsible for this deterioration and suggested that increased venous engorgement, increased extravascular fluid, capillary fragility and impaired venous or muscle tone play a role."

Finally, the psychogenic sequelae are too easily overlooked. With some physicians who are particularly adept at handling this problem, and who are constantly aware of it, the number of patients so harmed may be relatively few. The great majority, however, do not escape so easily. It is with alarming frequency that one sees in the clinic patients who have had myocardial infarction but who have been pitifully inactive because of symptoms brought on by fear rather than heart disease. In the increasingly older population the economic factors, even if the emotional ones could be disregarded, are serious enough to make further investigation imperative.

In summary, then, there are two main aims in the treatment of myocardial infarction. The first is the immediate saving of the patient's life, and the second is to prepare him for further living. The latter has probably often been neglected in the earnest desire to accomplish the first. We believe that the greatest fault has probably been not only in the length of bed rest but also in the rigid routine that is practiced. In most cases this includes four weeks of absolute, or nearly absolute, bed rest followed by varying lengths of inactivity so that rarely is the patient without residual symptoms returned to normal activity in less than three months. It is ridiculous for patients, who have not even been allowed to feed themselves to perform the dangerous Valsalva experiment upon the bed pan daily,[7] owing to their unaccustomed constipation. Actually, it is impossible to accomplish to even a reasonable degree what is desired by the orders of "complete bed rest" or "coronary precautions." This is clearly shown by Stead's[27] experiments, in which emotions are shown markedly to increase cardiac output — perhaps more frequently in these patients forced into undesired recumbency than would occur with gradually increased, intelligently guided activity.

It is important and lamentable that prolonged bed rest has become such a recognized part of the treatment of myocardial infarction in the eyes of both the patient and the physician. This makes it difficult for those who desire to recommend earlier ambulation since an unfortunate incident or coincidence may damage the reputation of the physician. In truth, many honest physicians have admitted that this is the prime reason for keeping their patients in bed.

It is our considered opinion that routine prolonged bed rest in myocardial infarction is not only unnecessary but also potentially harmful to the mental and physical well-being of the patients. Two weeks in bed, with reasonable, carefully explained restrictions, and possibly bedside toilet privileges, would be all that is necessary in the majority of cases. Even during this period some gradually increasing activity might be begun. After this, in the absence of contradictory symptoms and signs, patients should be gradually and progressively allowed to walk until at the end of four weeks from the onset they have regained some of their previous exercise tolerance and are prepared to leave the hospital on light activity. By this method not only would the patient be able to return to gainful occupation sooner but perhaps some of the physical and mental disturbances of bed rest would be circumvented. Obviously, there will be a certain number of cases in which extensive infarction would require modification of this procedure.

The foregoing recommendations do not appear to be in conflict with presently known facts, but it must be emphasized that applicable statistically valid facts are few. It is to be hoped that the treatment of myocardial infarction may one day rest on the results of purposeful clinical study, rather than mere reasoned opinion. In any case, although we believe that bed rest in most cases can be advantageously and safely shortened, no blanket recommendation applicable to all patients can or should be offered.

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MEDICAL PROGRESS

CURRENT PROBLEMS IN PHYSICAL MEDICINE AND REHABILITATION

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BOSTON

PHYSICAL medicine is an enigma to many doctors and lay groups. This may be in part explained by the paradoxical situation that it is at one and the same time a very old and a new medical specialty. The use of physical agents such as sun, heat, water, massage and exercise for therapeutic purposes can be traced back to earliest records. The acceptance as an established portion of scientific medical practice is relatively new, and physical medicine is one of the most recently accepted specialty boards. Soon after it was established, however, rehabilitation was added to the name. This term makes the meaning of the activities in this sphere understandable to lay groups and should tend to co-ordinate opinion and training in the field. To clarify further what is meant by the term physical medicine recent developments are briefly traced.

One should consider what has happened since World War I. At that time physical therapy, or physiotherapy as it was called, received a great boost. The few doctors who confined their practice to this type of work were spurred on by utilization of physical therapy in the treatment of war casualties. One of these physicians was Dr. Granger, of Boston. The value of physiotherapy and its utilization have gradually increased since then. For the most part the actual treatments have been delegated to technicians, first known as physiotherapists and later as physical-therapy technicians, to distinguish them from physical-therapy doctors. The latest nomenclature is that of physical therapist for the technical group, and physiatrist for the physician group.

Numerically, the orthopedic surgeons have utilized physical therapy more than any other single group of doctors, and consequently it has been applied most often to conditions affecting the muscles, bones and joints. A small group of physicians have devoted the majority of their professional time to the study and practice of physical therapy. The earliest of these were known as the American Physical Therapy Association dating back to 1885, and the present group, the American Congress of Physical Medicine, which amalgamated with them and is of about twenty-five years' duration. The American Medical Association at about the same time as the Congress recognized the importance of activities in this field of medical practice and established the Council on Physical Therapy, whose name was later changed to Physical Medicine and Rehabilitation. The Council and the Congress have been the two bodies most influential in shaping the scientific progress of the specialty and many papers of special interest to those concerned with the field are published in their journal, the *Archives of Physical Medicine*. Another journal, *Occupational Therapy and Rehabilitation*, has more recently been designed to include papers on the subjects indicated by the title for the increasing number of physicians in the field.

The American Congress of Physical Medicine is perhaps unique among specialty organizations, if it can be called one, in that the bulk of its membership has been made up of general practitioners and the purpose of the organization has been to instruct those in the general practice of medicine in aspects of physical medicine that may be valuable to them. In the beginning, physicians limiting their practice to physical therapy were especially concerned with the utilization of various electric currents, including high-frequency radiation, and made many contributions on this subject. The Council on Physical Medicine holds a very important position in this field as a referee to pass on the flood of electric apparatus that has been manufactured. Acceptance by the Council is now an established standard to be used by those seeking information regarding physical-therapy equipment. At present this field also includes physicians who have a primary interest

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in the later stages of disease, in which rehabilitation procedures assume prime importance.

Another important aspect of development of physical medicine has been the maintenance of adequate standards of education of physical-therapy and occupational-therapy technicians. In the past, largely because of lack of education of physicians in the technics of physical and occupational therapy, tremendous responsibilities have been placed in the hands of the technical group. This has been realized by them, and, to protect their own interests as well as those of patients, high educational standards have been required by the professional organizations, the American Physical Therapy Association and the American Occupational Association. The fundamental approving body is the Council on Education and Hospitals of the American Medical Association, which sets the standard and content for the training courses. Further qualifying boards are those of the American Registry of Physical Therapy Technicians and a similar registry of occupational therapists. The academic standard in these training schools has steadily increased over the past twenty years, the majority of them now offering bachelor degrees in affiliation with universities; physicians or surgeons seeking the services of technicians in this field should make sure that the therapists employed have had this proper educational background.

The education of physicians in physical medicine has been somewhat slower, but steady progress has been made. This has been greatly stimulated by gifts from Mr. Bernard Baruch, whose father, Dr. Simon Baruch, was a leader in the field. Further stimulation was provided by federal services, particularly the Veterans Administration, and at present there are over forty residencies offered in the United States whose successful completion will enable men to meet the requirements of the specialty board.

Occupational therapy has not been so closely allied to physical medicine as physical therapy until recently. A close correlation of physical and occupational therapy in orthopedic conditions and in many rehabilitation programs is beginning to be fully realized, including the services of ancillary groups such as those designated as corrective therapists and manual-arts therapists in the Veterans Administration hospitals. The complete team of medical-rehabilitation personnel also includes psychologic testers, vocational-rehabilitation counselors, educators and medical social workers.

Although physical medicine and rehabilitation is primarily concerned with special problems of therapy, it should be pointed out that the practice of physical medicine includes certain diagnostic procedures. Most commonly these consist in evaluation of nerve and muscle function, including strength and electric excitability tests, electromyography and certain tests of peripheral circulatory efficiency and sensitivity to radiation. In the field of rehabilitation this testing includes evaluation of functional achievement in everyday activities and also in special occupational skills.[1]

The therapeutic application of physical agents covers first of all a broad band in the electromagnetic spectrum, all the way from the very short ultraviolet wave lengths through visible light, infrared or heat rays, to alternating electrical currents, ultrasound and high-frequency radiation most recently developed and known as microwaves which are basically related to radar. The use of these physical agents is applied biophysics, physics being a basic science with which the physiatrist must be conversant. Massage and exercise are other commonly used procedures whose relation to physics is not so apparent, being chiefly applications of the principles of mechanics. In this instance one must turn to the physiologic laboratories for most of the fundamental information concerning the effects of motion both passive and active upon circulation, joint function, muscle strength and, finally and most important of all, motor skill. The effectiveness of all such treatment is in large part dependent upon fundamental knowledge of the physiologic effects and resultant ability to prescribe with precision to achieve the desired results. Another frequently utilized treatment is that of hydrotherapy, which includes the mechanical effects of water pressure and movement, temperature and, when exercise is employed at the same time, the buoyant effect and also resistance from the viscosity of the fluid.

Analysis of occupational therapy and of the numerous valuable rehabilitation procedures in training people in everyday activities is not as readily accessible to laboratory technics as that of procedures in physical therapy. Statistical analysis and critical observation enable one to determine, however, what activities are useful. Training and experience can then permit a careful prescription for the use of these therapeutic agents. A recent textbook on occupational therapy for physicians is helpful in educating the doctors in the correct use of this important ancillary service.[2]

Without going into further details, I think it is apparent that the practice of physical medicine is based on an understanding of the physical and physiologic effects of a great variety of widely different physical agents. It is admitted that large gaps are present in knowledge that will require persistent research in the future, but a solid background of practical information is already available. Experience is also building up information on technical procedures in rehabilitation, which are of tremendous practical significance. Physical medicine and rehabilitation has perhaps the broadest scope of any of the medical specialties, for it is concerned with nearly all the other subdivisions. This can perhaps best be illustrated by some examples of its application.

Medical Conditions

Rheumatoid Arthritis

It has been estimated that approximately 140,000 persons in Massachusetts suffer from rheumatoid arthritis who might well benefit by physical medicine and rehabilitation as a part of their treatment regimen. The problem of treatment is different from that in many other disabilities that are static because this disease tends to be chronic and is often progressive, although many patients, of course, improve and may be actually cured, particularly in view of the recent benefits shown by endocrine therapy. It is well known to those most closely connected with the treatment of the disease that often patients who have shown good improvement have not returned to gainful employment so that without a doubt there is an unsolved problem of rehabilitation. It has been pointed out by the best authorities that personal problems may play a major role in the symptom complex, and psychotherapy concurrent with the medical program is frequently advisable. Because of these special characteristics of the disease many patients do not fit into an active, pushing rehabilitation program suitable for static conditions. It is advisable that all these patients maintain a close personal contact with, if possible, a single physician who guides the total medical program, bringing in consultants such as physiatrists and orthopedic surgeons when needed. It seems certain that there is a need for vocational guidance adapted to the individual patient, retraining programs and, finally, employment liaison officers. Because of the individual nature of this disease it might be well to establish some pilot experiments in rehabilitation rather than inject these patients into more standardized channels.

Degenerative Arthritis (Osteoarthritis, Hypertrophic Arthritis)

The majority of patients with degenerative joint disease do not present the difficult problems of medical rehabilitation present in those with rheumatoid arthritis. The joint lesions can in general be handled satisfactorily with technics that are now known and recognized to be of value.[3] These include, of course, dietary control, physical therapy, particularly in the form of exercises and correction of mechanical deformities, and the use of certain orthopedic appliances. Occasionally, reconstructive surgery, particularly of the hips, is useful. The disease usually attacks older patients, is not rapidly progressive, and usually does not necessitate a change of employment.

Tuberculosis

The patient with pulmonary tuberculosis also requires a special form of medical rehabilitation. Here, again, one is dealing with a more or less chronic disease in which the rehabilitation program must be begun during hospital or sanatorium treatment and continued after discharge. Efforts in this field should first be directed toward proper utilization of the long period of hospitalization for preparation of the patient for ultimate employment. Good programs include occupational therapy, educational therapy and physical conditioning planned according to the status of the patient. Such patients who can visualize a place in life after discharge have a mental stimulus that aids recovery.

It is, of course, of utmost importance that the physical demands of the contemplated job for the patient fit his ability to withstand strain. Evaluation of physical fitness or working capacity is extremely difficult by any single measurement. Experience has shown, however, that testing of work tolerance is a fairly well established and successful procedure. This can be begun in the occupational-therapy shop, where some prevocational training can be started, followed after discharge by employment in sheltered workshops or proper placement in industry. The vocational counselor must, of course, be familiar with the nature of the disease as well as what types of employment are suitable. There appears to be some prejudice on the part of industry against placement of such persons; this is not warranted by experience, since modern industrial situations only rarely involve unduly heavy manual labor. The difficulty is perhaps largely a psychologic one that it is the duty of the physician and the whole rehabilitation team to combat, including employers and fellow employees. This education of the public and the patient is a primary need in rehabilitation of tuberculosis.

Heart Disease

Proper rehabilitation is one of the most important problems in the care of the patient with cardiac disease. These cases, first of all, must have an accurate diagnosis and must be classified according to etiology as well as functional ability. This may be divided into four groups, beginning with no limitation of physical activity, to slight, marked or complete limitation. Other diagnostic measures include evaluations of the aptitude of the patient for different types of employment. In considering treatment of heart disease in relation to rehabilitation it should be emphasized that work is good therapy, provided the patient is properly adjusted to the work conditions. It should be realized that cardiac patients can be employed with safety. Transportation, however, often presents a difficult problem, and for this reason work has to be provided in their own homes for many patients. Problems of compensation may come up that tend to keep them from working, and the laws might well be studied from this point of view. Other special problems include the necessity of absence from work in case of infection, which should be properly understood by the employer. Research is needed

to develop methods to evaluate more quantitatively the working capacity of the patient and the physical demands of various types of employment. Such studies are at present being carried out in different centers with combined teams including internists and physiatrists. In considering the over-all needs, exact figures of the number of cardiac patients needing work are not available, but it is certain that the average patient can anticipate enough years of life in which he can be gainfully employed to make efforts for rehabilitation sound, both for their value to the patient and for the service rendered to the public by his productive work.

Geriatric Conditions

In view of the steadily increasing population of elderly people, there are more and more partially incapacitated persons presenting another challenge for physical medicine. In the hospitalized group there are often many conditions, such as degenerative arthritis, peripheral vascular disease and neurologic disorders, that may profit by physical therapy as in younger age groups. Certain modifications of technics are, of course, necessary, depending upon cardiovascular status and strength of the muscles and bones. Many mental complications can be avoided by the judicious use of occupational therapy. Rehabilitation procedures include evaluation for achievements in activities of daily life and, in certain cases, some possibilities for a degree of productive occupation. This may include piecework in the hospital and occasionally other types of sheltered occupation, but rarely competitive employment. Physicians in charge of such work must have wide knowledge of general medicine so that the physical medicine and rehabilitation activities prescribed will be well adapted to the physical capacities of the patient. There appears to be a place for limited departments of physical medicine in all chronic-disease hospitals and in institutions for the elderly.

Hemiplegia

Hemiplegia is caused from damage to the brain but is included under medical conditions rather than neurologic because these patients usually have generalized vascular disease and are under the care of physicians rather than neurologists or surgeons before their attack. It should be realized that when the brain is sufficiently damaged to cause hemiplegia, total restoration is not to be expected by natural processes or any form of treatment. The degree of recovery possible varies according to the location and extent of the lesion, and in a certain percentage of cases satisfactory rehabilitation is impossible. In addition to the mental and physical disability caused by the brain damage, there is an element of anxiety and insecurity that requires great courage on the part of the patient to combat. The medical profession should do everything possible to fortify the courage of these patients and to help them in the necessary adjustment. Placement in industry is especially difficult, and only the best of vocational rehabilitation and placement services can hope to be successful.

The first step in treatment includes the application of physical medicine as soon as the danger to life has been met by proper medical and nursing care. Such treatment includes prevention of deformity and instruction of the patient by careful supervision in the active use of the weakened extremities as soon as function begins to return. Simple positioning in bed may not be sufficient in all cases as spasm develops, and splints and braces may be used to advantage. The problem of muscle re-education is not just strengthening of weak muscles, but the elements of spasticity and loss of proprioceptive reflexes and position sense must be met by special technics, including training in relaxation and co-ordination. The severity of the defect is in part also related to the handedness and the resultant interference with language functions. Ambulation should not be delayed unnecessarily, and technics are readily available for teaching these patients in all well established physical-therapy departments. Occupational therapy is also of value psychologically and to aid the patient in matters of self-help in everyday activities and in the development of increased co-ordination and skill. Some diversional activities may be in order and often provide an incentive for living.

The ultimate goal for rehabilitation is variable. In some cases one may have to be satisfied with attaining the maximum degree of self-help as in everyday activities such as dressing, undressing, bathing and walking. A few patients may be able to return to their former gainful employment, but this is largely dependent on the attitude of the previous employer and the type of work the patient has been doing. The younger patient who had the hemiplegia after trauma and who has unimpaired mental facilities should be given every opportunity to have a complete service of vocational training and placement. There is hardly any patient who cannot be helped in some degree by proper administration of medical rehabilitation.

Surgical Conditions

Trauma

One of the most economically important functions of physical medicine is the treatment of traumatic conditions, particularly industrial accidents. The type of result is dependent first of all, of course, on the quality of surgical and medical treatment from the outset. For psychologic and practical reasons, at the time of first treatment in the hospital, plans should be laid for recovery and re-employment. The early use of physical medicine to aid in recovery of affected parts will do much to focus the attention of the patient on active treatment in which he par-

ticipates. This should include conditioning exercises to prevent unnecessary atrophic processes of general metabolism but particularly muscles and bones. If hospitalization is necessarily of long duration, occupational therapy may be quite useful to aid in adjustment, providing a proper mental background for recovery and, when the condition allows, aiding in functional recovery of the affected part. When the program is properly planned there should be a pattern of progress in the type of treatment in physical medicine from passive measures only to active exercise with assistance, followed by more strenuous strengthening measures and regaining of skill and co-ordination. After discharge there should not be a long period of waiting at home for spontaneous improvement before return to work, but a planned program of activity, usually some type of occupational therapy, and, in some cases, retraining when a permanent physical disability must be circumvented. Evaluation for vocational abilities and placement should be begun early and should be followed by good contacts with industry.

The details of physical medicine for various conditions such as fractures, burns and other injuries are already well recognized by those dealing regularly with these types of patients. There is, however, without doubt a great need for better co-ordination between surgeons rendering the immediate care and those responsible for final recovery and re-employment.

It seems apparent that there are not enough facilities available to the community for the rehabilitation of industrial accidents. In Massachusetts, where the law provides free choice of physician by the injured workman, the treatment may be given by his own physician in a small community where there are no facilities for proper aftercare. One or more rehabilitation centers in Massachusetts of the community type would certainly be of value for this type of medical problem. Such a center could start slowly in a field of definite need such as that of treatment of trauma and the patient with an amputated extremity, with well selected cases and with established technics. The keynote of success is proper co-ordination, including an efficient placement service. The treatment in the center should, of course, be under proper medical supervision.

Amputation

The subject of amputation is considered separately from trauma because of its importance and the special rehabilitation needs it occasions. To ensure the proper care of a patient who has lost an extremity there are four steps to be considered. In the first place, the amputation site must be properly chosen in terms of the fitting of a prosthesis, and surgical technic should provide a good stump; to ensure a good stump the aftercare must be properly managed, including measures to induce shrinkage and to prevent deformities. The next step is adequate prosthesis. The responsible doctor should have knowledge of what constitutes a good prosthesis and should help the patient in its selection rather than leave it up to the arguments of various manufacturers. Thirdly, the patient must be taught to use his limb. One insurance-company representative has indicated that as high as 85 per cent of patients provided limbs because of industrial accidents have failed to use the prosthesis. It is up to the medical profession to provide proper instruction to the patient in the use of the appliance. And, finally, the fourth step is to get the patient back on a job, preferably his old job, but if not, after evaluation of abilities, possibly retraining to a new and more suitable one. The first step, that of providing the patient with a good stump is fortunately almost universally possible in any of the many excellent hospitals. Doctors often fall down, however, in advising patients about what type of prosthesis to use and also in the last steps usually classified under rehabilitation or physical medicine — that of guiding him in proper use and of eventual re-employment.

Experience in the Army has shown that amputation centers where a number of patients with similar disabilities worked together in learning the use of prostheses provide a very effective way of handling this problem, and it seems quite clear that there is a need for amputation centers in several parts of New England. There is sufficient background of experience in rehabilitation to provide for instruction and guidance to any group interested in providing this service in their community. The chief lack appears to be adequate demand by the practicing physicians and surgeons for this service. However, it seems likely that if the physicians themselves do not demand it, the patients soon will.

Neurologic Conditions

Poliomyelitis

Patients with poliomyelitis in Massachusetts have been fortunate in being able to obtain a high type of medical care. Hospitals are available to care for patients and to save life during the acute stage of the disease for ordinary numbers of patients. During the convalescent stage, which may continue up to two years after the onset, physical medicine in the form of physical therapy consisting chiefly of a carefully supervised exercise program is the major treatment. There are still not enough physical therapists to give expert care for all patients during an epidemic, but experience has shown that people in the home can be taught these technics to a fairly satisfactory degree. In the chronic stage one aims to train around residual defects and to reduce handicaps with surgery and mechanical devices. The greatest lack is probably in going finally from this stage to that of employment, but

when there is a relative manpower shortage some degree of physical disability has not been found to be of great disadvantage to patients who have a nonprogressive condition.

Crippling Diseases in Children

Other types of crippling conditions that occur primarily in children are those related to congenital anomalies. Success is often dependent on early treatment under the care of experienced orthopedic surgeons. This treatment may extend throughout the growing period but can often be handled in a general hospital. The home care is also important, for before the child's discharge from the hospital the parents must be educated in how to care for him in the home and assure proper medical follow-up study. For those economically unable to obtain these services, which are available in the teaching centers, the state should spend money in order to save money later, since the patients so treated are made economically independent.

Cerebral Palsy

The care of the child with infantile cerebral palsy requires special technics and usually a team of specialists. In establishing the program of care the first essential is to determine the mentality of the child so that efforts will not be needlessly spent on those whose rehabilitation is hopeless. Parents of mentally deficient children put great pressure upon people dealing with the care of cerebral palsy. It is certainly necessary, therefore, that a good screening unit be provided for proper selection of patients.

Many children can be treated at home by instruction of the parents in conjunction with a well arranged plan through a hospital therapy unit. Another problem is that of providing education for the child, which, for children with milder defects, can be given by special teachers in hospitals, homes and schools. For some, special therapy schools must be provided so that treatment may go hand in hand with education. There remain, unfortunately, one group that will always require custodial care and another group that may thrive profitably in a sheltered environment such as on special farms or other industrial colonies.

The medical profession should be concerned with this problem from its beginning and should direct it through to the final outcome. This includes proper selection of patients so that rehabilitation proceeds to its proper goals, avoiding building up hopes and promises of ability to compete economically with others when this is going to be obviously impossible, but still providing every opportunity for the fullest productive life. The problem of caring for the many children with cerebral palsy in Massachusetts has not been solved, although the manner of achieving these goals from a medical point of view is generally known.

Paraplegia

Rehabilitation of paraplegic patients is relatively a small problem as far as numbers are concerned. In the past it has been said that about 70 per cent of patients died during the first year and that the rest stayed in bed with a life expectancy of not over five years; during this time they were without any earning power and had no normal enjoyment of life. The situation during the past ten years has changed. It is now known that a person can live a fairly normal life with a fairly normal life expectancy. Experience in local Veterans Administration hospitals has shown that 68 per cent of a group of over 200 paraplegic patients became fully ambulant.

Medical knowledge has obviously greatly increased, since physicians have learned to save life, prevent or overcome deformities, manage the problem of care of the genitourinary tract and teach patients how to become ambulatory with a high degree of self-care and preparation for employment. The weakest point in all this is that of employment. There are always a few on pension who refuse to work, but it seems that the lack of a plan of employment is the greatest problem. This is explained by many factors such as the fear of the employer if he hires a paraplegic person, as well as the fear of the insurance company. The seniority rules of the unions also work against reemployment. There is also the weight of public opinion against it and the tendency to consider the patients charity cases. This attitude is unnecessary, displaying the ignorance of the lay public and the medical profession in the possibilities for these patients. From the point of view of economics, again, it can be shown that if they are simply considered as permanently and totally disabled, a reserve of $25,000 to $50,000 has to be put aside to care for each of them. If the best type of modern methods of medical care and rehabilitation is employed, the cost has been estimated to amount to only $7,500 for the average case, which, of course, in the long run indicates a great saving to society and points out again that money should be spent in order to save it. The problem is not to find out how, but to provide the facilities needed.

Speech Rehabilitation

There is an increasing emphasis on the importance of oral communication as indicated by increasing demand for courses in public speaking, conference technics and other speech courses to develop effective leaders to improve human relations. The trend has been away from emphasis on speech training for the talented to practical training for all. This general awareness of the importance of speech has focused attention on those in need of speech rehabilitation, and special professional organizations have been formed for this purpose.

A person may need speech rehabilitation because his speech cannot be heard or understood by his listeners; his speech pattern may call attention to itself and react unfavorably on his listeners, or the patient may react unfavorably to his own speech and become maladjusted. The defective speech may be the result of structural abnormalities, neurologic disturbances, defective hearing or psychologic disturbances, some degree of the latter being present in almost all persons with defective speech.

The different types of speech disorders are those of articulation, voice disorders and stuttering, speech problems of patients with cerebral palsy and deaf and aphasic persons, and the patient with a cleft palate or lip. The first step in rehabilitation is to classify properly the type of disorder present, and a specially trained expert is usually necessary for this purpose. Diagnostic procedures also include analysis of the social adjustment and psychologic behavior of the patient. A new and special problem in speech rehabilitation is caused by laryngectomy for cancer. Such patients must develop esophageal speech by special technics and learn to use a "new voice."

Methods of treatment for these different groups have been rapidly developed over the recent years and appear to be most effective when speech units are developed, although they may well be part of a general clinic or hospital. The problem seems to be chiefly expansion of facilities to provide care for all those requiring it. Problems of the deaf may often be handled in the same or closely affiliated units.

The Blind

Loss of vision is accepted as a most serious physical handicap. This is due to the effect of loss of sight on so many factors in everyday life. From an aesthetic point of view much of the beauty of the world is lost, and at the same time the patients lose confidence in their other senses. Mobility and independence and, of course, financial security are greatly interfered with. Everyday activities of daily living are limited, as are recreational facilities. The patients also lose the assurance that comes from easy communication and a feeling of social adequacy, all of this, of course, having its effect upon the personality organization. To carry on rehabilitation procedures for the blind, special agencies are set aside, the first state law for this purpose being passed in Massachusetts in 1906; now there are 46 states with such special programs.

Facing the problem in Massachusetts, where there are estimated to be nearly 7000 persons who have vision of 20/200 or less, one must consider that the majority are over fifty and cannot expect to be industrially rehabilitated. The treatment of these persons may fall into the field of geriatrics, since they often have other medical problems. In general they do not wish to be segregated, and get much help from a sense of usefulness. There is considerable value, however, from a rehabilitation center for the blind as proved by those already established in various parts of the country. There are special placement problems that can be considered with the proper program, including facilities for sheltered employment.

Blind children present a special problem in education that begins in the preschool years. The program should then follow through to training and placement. In general it is sound to give more extensive training for blind persons because learning is more difficult for them, including correction of mistakes, and if superior training is achieved they are more able to compete with people who can see. Many of the problems of emotional control can be solved through psychiatric outpatient department clinics, including those providing group therapy and follow-up study by psychiatric social workers. Again, the public needs education so that these patients will not be segregated but will be treated as normal people.

Epilepsy

Education of the general public again stands out as a primary need when rehabilitation of patients with epilepsy is discussed. It has been estimated that only 10 per cent of epileptic patients need to be institutionalized and are nonemployable, and 80 per cent, with adequate medical care, can lead a normal life and are capable of training for employment. Certain restrictions, of course, have to be kept in mind such as avoiding heights, machinery, fire, water and occupations with a risk of injury to themselves or others. That these patients are poor risks in industry can well be disputed, since some company experiences are excellent. There are, however, few centers for training, and all those available are not used, including community workshops or other sheltered workshops and the established employment services of the Government. To accomplish more, epileptic patients must be urged to get adequate care, and the truth about epilepsy must be spread so that opportunities will be available for them.

Other Chronic Neurologic Disorders

There are a number of degenerative diseases of the nervous system more or less progressive, although usually very slowly, in which a certain degree of rehabilitation is possible. These include such conditions as multiple sclerosis, syringomyelia, Parkinson's disease and tabes dorsalis. As in any chronic progressive disease, it is important first of all that adequate medical care be provided so that whatever therapeutic drugs are available are used. If neglected, these patients soon reach a level of daily activity at which they become totally dependent. Physical-therapy technics can do much to increase the functional level by special exercises,

including training in skills usually provided by occupational therapists and at times mechanical self-help devices. If these facilities are available, many patients can remain at an occupation for which they are trained provided certain adjustments are made in transportation and skilled use of extremities. Some may receive much help from vocational analysis directing them in a new sphere of activities in which they are able to carry on in spite of increasing disability. Patients with more severe involvement can usually at least be taught to help themselves, thus freeing people in the home for employment. Much of this type of work can be done in a department of physical medicine in a general hospital or by a few weeks or months of treatment at a rehabilitation center.

Psychiatric Disabilities

A large percentage of the patients who have one of the various disabilities discussed above have some disorder of personality that may require the services of a psychiatrist, and such consultant psychiatric aid is generally accepted as having a role in the medical team doing rehabilitation. In addition there are, of course, the large numbers of hospitalized psychiatric patients, who represent a tremendous problem. The best mental hospitals have departments of physical medicine and rehabilitation where plans are started to train suitable patients for occupations after discharge. One difficulty is the provision of suitable follow-up care when the patients first leave the hospital, from the point of view of psychiatric aid, social service and contact with employers. The principles governing treatment of psychiatric patients suitable for rehabilitation are well known, but there are not enough trained personnel available to offer such services to the large numbers of psychiatrically disabled patients.

Rehabilitation in the Veterans Administration

A most comprehensive plan of physical medicine and rehabilitation was organized at the end of the war to care for veterans in the Veterans Administration hospitals and the regional offices. Special physicians trained, or to be trained, in physical medicine are designated to run the departments of physical medicine and rehabilitation, such departments having equal standing with other professional services. Treatments are divided into sections, including physical therapy, occupational therapy, educational therapy, physical reconditioning or corrective therapy, and shop retraining or manual-arts therapy. The organization calls for specially trained personnel in each of these subdivisions and also for considerable space and equipment to carry out the plan. An important feature of the organization is the establishment of a medical rehabilitation board consisting of representatives from the department of physical medicine and rehabilitation and physicians on the medical, surgical and neuropsychiatric services. These rehabilitation boards act to plan the proper hospital program of treatment, including employment after discharge.

This appears to be an ideal manner of treating disabled veterans. Experience has shown that there are not enough trained personnel to complete such an extensive organization in every veterans facility, and progressive economies have eliminated some of the services from time to time. Perhaps the greatest shortcoming has been lack of adequate follow-up care and contact with industry for placement, but the medical principles outlined are excellent and worthy of encouragement and efforts by all to fulfill the ideals of such total rehabilitation.

State Program of Vocational Rehabilitation

The majority of physicians in Massachusetts apparently are not aware of the existence of the Division of Vocational Rehabilitation, since they do not make use of it. Federal legislation has provided for aid to properly set up state programs of rehabilitation. The purpose of this service is to correct remedial defects and to give vocational training and guidance so that persons who are now dependent may become self-sufficient and gainfully employed. A person to be eligible must be of an employable age or must reach that age after a brief period of further education. A patient with some medical condition or physical disability must have a general medical examination with his own choice of physician and then a specialist examination, if indicated, to determine acceptability for rehabilitation. A planned service is then provided by means of the medical adviser and the vocational-rehabilitation counselor. Medical and surgical treatment may be furnished if indicated, as well as any necessary prosthetic devices or appliances. Testing is done for vocational aptitudes, and often alternative training programs are submitted to the patient. This may include work in industrial schools, apprentice training and other educational activities. Placement in industry is achieved through the regular state employment agencies and special placement offices of the Division of Vocational Rehabilitation. Follow-up services are also provided by the same state officers.

Although the framework for what appears to be an excellent medical-rehabilitation service is available, the record does not show proper results in Massachusetts, since during the past two years there have been relatively fewer case referrals and fewer placements in industry than in any other state in the Union. The reasons for this are, of course, multiple. One is that sufficient pressure is not placed upon legislators to appropriate sufficient funds. This delinquency, however, primarily goes back to the physicians of the Commonwealth, who have failed to refer their patients to this service

and accordingly have not demonstrated to the legislators the need for adequate appropriations. There appears to be no good reason besides lack of information to explain why existing facilities for rehabilitation are not properly utilized. This is being done with increasing frequency in other states with good economic return to society through successful rehabilitation that more than pays for its cost. It is accordingly apparent that the physicians of Massachusetts and New England need a great deal of education in the field of physical medicine and rehabilitation so that present facilities will be fully utilized and new ones demanded.

In consideration of the problems now confronting those concerned with national health and in particular medical problems in New England, the Massachusetts Health Conference devoted a panel to the discussion of physical medicine and rehabilitation last year. This panel discussion was participated in a by a number of New England experts* in the field, and the valuable contributions they made have formed the basis for a large part of this paper. Several recent textbooks give further details,[4-7] and in addition frequent articles appear in the journals of *Occupational Therapy and Rehabilitation* and the *Archives of Physical Medicine.*

*These included: A. Dudley Britton, American Mutual Liability Insurance Company; Edward D. Callahan, director, Division of Vocational Rehabilitation; Mrs. Emma S. Tousant, commissioner, Massachusetts Industrial Accident Board; Arthur L. Watkins, M.D.; Walter Bauer, M.D.; Stanwood L. Hanson, Liberty Mutual Insurance Company; Lewis C. Robbins, M.D.; Rev. Thomas J. Carroll, director, Catholic Guild for the Blind; George W. Van Gorder, M.D.; Jacob Rudd, M.D.; Miss Esther C. Walther, past executive secretary, American Epilepsy League; Donald Munro, M.D.; William T. Green, M.D.; Wilbert L. Pronovost, Ph.D., director of Speech Clinic, Boston University; Mrs. Dorothy Oates, supervisor of Physical Restoration, Division of Vocational Rehabilitation, Massachusetts Department of Education; and Sidney Licht, M.D.

Summary and Conclusions

The specialty of physical medicine and rehabilitation is described, and its application in a broad variety of medical conditions outlined.

There is a fundamental need for further education of physicians and the public in the aims and possible accomplishments of physical medicine.

Educational needs also include training of more physicians and technical personnel in this specialty.

Present facilities need expansion, and new units should be developed, including, in particular, rehabilitation centers.

Although it can be shown that rehabilitation in the long run is economically profitable, financial assistance is needed to expand and maintain it at a local level.

Physicians should take full advantage of present facilities and governmental funds, which are now legally available but not fully utilized in Massachusetts.

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CASE RECORDS OF THE MASSACHUSETTS GENERAL HOSPITAL

Weekly Clinicopathological Exercises

FOUNDED BY RICHARD C. CABOT

TRACY B. MALLORY, M.D., *Editor*

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CASE 36391

PRESENTATION OF CASE

A sixty-four-year-old housewife was admitted to the hospital because of extreme pain and swelling of the right arm.

She had been well until twenty-two months before admission, when she noted the gradual onset of pains in both knees and then massive swelling about the right knee and fever. On examination the knee was tender and swollen. She was treated with sulfonamides, remained in bed for three months and then used crutches for another three months. Following this she was able to go about her usual activities without pain or difficulty. Five months before entry pain in the right elbow developed, increasing in severity and accompanied by progressive swelling first of the elbow and then of the entire arm from the hand to the shoulder. The pain was exaggerated at night but was not associated with fever or any other subjective complaints. She had lost 18 pounds of weight during the year prior to entry although her appetite had been good. Five weeks before entry examination in another hospital showed marked swelling of the arm from the midarm to the tips of the fingers, with moderate tenderness over the elbow, and shiny, discolored skin. The right knee was slightly tender on the outer aspect around the head of the fibula, but there was no limitation of motion and no masses were described. Urinalysis demonstrated a normal urine except for 12 to 15 white cells per high-power field in the sediment. The test for Bence–Jones protein was negative. Examination of the blood disclosed a red-cell count of 3,800,000 with a hemoglobin of 66 per cent, and a white-cell count of 8150, with 78 per cent neutrophils. The nonprotein nitrogen was 28 mg., the total protein 5.7 gm., the phosphorus 5.1 mg., the sugar 88 mg., and the alkaline phosphatase 3.28 units per 100 cc. The blood Hinton test and cultures of subcutaneous fluid from the elbow were negative. X-ray examination of the arm showed almost complete destruction of the distal third of the humerus, including both condyles and epicondyles. The elbow joint was almost completely destroyed. There were irregular, filmy masses of decalcified bone scattered in the soft tissues, but the outline of the humerus was lost. The entire shaft of the humerus showed marked demineralization and moth-eaten bone destruction. There was a pathologic fracture of the upper portion of the shaft about 3.5 cm. distal to the surgical neck. There was no evidence of new-bone formation in any part of the humerus. The bones of the forearm and shoulder girdle showed generalized demineralization without definite evidence of bone destruction. There was massive soft-tissue swelling without evidence of a discrete soft-tissue mass. Films of the right knee showed irregular bone destruction and fairly extensive new-bone formation involving both condyles and the proximal few centimeters of the shaft of the tibia. There were small, rounded foci of radiolucence suggesting small cavities in the bone. The outline of the bone was fairly well preserved except anteriorly and laterally on the condyle, where there was an irregular projection of bone without a definite cortex. The joint space was preserved but narrowed. Chest films were not remarkable. Despite incision and drainage of the elbow region and penicillin, the patient did not improve and was admitted here for further therapy.

On physical examination the pupils were small and reacted to light. The patient was oriented but slow and hesitant of speech. Knee jerks, ankle jerks and position sense were normal. There was no adenopathy. Thoracic, abdominal, pelvic and rectal examinations were negative. There was an ill defined thickening in the right upper quadrant of the right breast that was fairly firm and tender. There was massive swelling and brawny edema of the right arm from the shoulder girdle to the finger tips. Crepitus about the shoulder girdle suggested underlying gas, and all motion was extremely painful. A large, fungating, necrotic and deeply ulcerated mass was present on the medial and lateral aspects of the right elbow, with large pieces of humerus easily picked from the wound, which drained foul exudate. There was no muscle power in the right hand and forearm, and the radial pulse was weakly palpable. The contour of the right knee was distorted, and at the joint line on the lateral aspect was a nontender, fairly firm mass. There was lateral instability of the knee, with crepitus but no pain. Moderate effusion was present. There was 2.5 cm. of shortening of the right leg that was apparently due to changes in the proximal tibia.

The urine had a specific gravity of 1.008 and gave a ++ test for albumin, and the sediment con-

tained rare red blood cells and 10 white cells per high-power field. The hemoglobin was 10.2 gm. per 100 cc. The white-cell count was 17,400, with 95 per cent neutrophils. The total protein was 5.4 gm., the fasting blood sugar 125 mg.; the calcium 9.1 mg., the phosphorus 2.4 mg., and the phosphatase 9.0 units per 100 cc. Culture of the necrotic tissue from the elbow process revealed colon bacilli overgrowing *Bacillus pyocyaneus* (*Pseudomonas aeruginosa*) and nonhemolytic streptococci. Two blood Hinton tests were negative.

The patient was placed on Crysticillin and streptomycin, with coincident lowering of the temperature from levels of 102 to 104°F. to normal for two days preoperatively. On the fourth hospital day a guillotine amputation of the right arm was done at the level of the axilla through apparent tumor tissue. Copious quantities of purulent exudate drained from the shoulder joint and from the supraclavicular area. The humeral head was left behind as a shell of necrotic tissue. Pathological examination showed a malignant lymphoma, clasmatocytic type, involving the humerus and the soft tissues of the arm and upper portion of the forearm.

Postoperatively, with the relief of pain from the arm, the patient was considerably improved. She did complain of some discomfort in the right knee on the day after operation, and a moderate effusion was present. On the sixth postoperative day the temperature, which had ranged between 99 and 102°F., spiked to 104°F. A blood culture showed no growth. A moderate amount of greenish discharge exuded from the amputation stump. The white-cell count was 6100, with 98 per cent neutrophils and 2 per cent monocytes. Aureomycin was substituted for streptomycin, and x-ray therapy (1200 r) was given to the right shoulder in the course of the next week, with fairly good control of the fever. On the eighteenth postoperative day the patient had a clonic convulsion lasting about three minutes and involving first the right leg and the right side of the face and then the left cheek and the left leg to a lesser extent. Immediately following this there was a paralysis of the right facial nerve. She could answer a few simple questions but refused voluntarily to move the arm. The ankle and knee jerks were equal but hyperactive. The Babinski test was negative, and there was mild ankle clonus. Within an hour the facial weakness had cleared, and the patient was rational. She had three similar seizures during the next twelve hours. A lumbar puncture showed clear spinal fluid with an initial pressure equivalent to 60 mm. of water. There was rapid rise and fall in pressure with coughing and jugular compression. The fluid contained 11 red cells and 25 white cells per cubic millimeter, of which 13 were neutrophils and 12 lymphocytes. The total protein was 61 mg. per 100 cc. Despite the recurrent seizures she presented only the facial weakness and the slowness of response on repeated examinations. She did complain of some headache with these episodes, and there was some questionable neck stiffness although she could place her chin on her chest. Within three days of the onset of the convulsive seizures a complete left hemiplegia had developed, without a trace of motor power in the left arm and leg. The reflexes were hyperactive, but Babinski and Hoffmann signs were negative. She was poorly oriented and lapsed into coma. The temperature ranged daily from 102 to 104°F., and with little obvious change in the findings she died approximately a month after admission.

Differential Diagnosis

Dr. Joseph C. Aub*: This is the only clinicopathological case I have ever discussed in which the pathologist has given a diagnosis, and I suspect these free gifts.

The problem is what caused the patient's death and what she had in the kidneys, breast and central nervous system. I think before I tackle that, I should like to see the x-ray films.

Dr. Tracy B. Mallory: I regret to report that the x-ray films of this case have disappeared.

Dr. Aub: I do not care. I have to make a diagnosis of lymphoma of the clasmatocytic type in this case. It would be rude of me to suggest that the pathologists, who had the whole arm, were not able to make a correct diagnosis. I think also one has to make a diagnosis of infection superimposed on a tumor in the arm. The arm was punctured and cultured, and the culture was negative. Then the surgeons opened the arm and found a tumor. I do not know whether it was infected at that time or not, but I assume that it was not, that the tumor bulged out of the wound and that it was infected secondarily. It was a rather severe infection that spread up and down the arm so that at the time of amputation the patient had a continuing infection above the area of amputation, probably in tumor tissue.

During convalescence she began having convulsions. The history stated that on admission she was oriented but slow and hesitant of speech, which is characteristically an early sign of a brain tumor, and lymphomas can produce lesions in the calvarium. These convulsions were bizarre, for they started on the right side and spread to the left arm and leg. When the patient came out of them, she had weakness and eventually paralysis of the left arm and leg.

There is no evidence in the history that she had an occluding lesion in the spinal cord, where most of the lymphomatous lesions are likely to appear. The cerebrospinal fluid had no difficulty in migrating from the calvarium into the spinal cord. But lymphomatous lesions do occur in the central nervous system. They occur not only in the meninges, where they are most common, but also rarely

*Physician, Massachusetts General Hospital.

in the brain substance itself. If I interpret this correctly, the patient had evidence of a meningeal involvement when she entered the hospital because she was slow and somewhat comatose. This progressed, thereby implying that the lesion increased in size. If it was a meningeal lesion that affected the facial nerve on the right and eventually caused a complete paralysis of the arm and leg on the left, there would be a rather widespread involvement of the right hemisphere. I can only put this together as a lesion that involved the meninges mostly and eventually involved and infiltrated into the motor area of the brain.

Was this lesion a malignant lesion, or was it a metastasis of infection? I find that extraordinarily difficult to decide. She had an infection, she had fever, and she had a very high polymorphonuclear count, but she had a very low lymphocyte count, which is not so very infrequent in lymphoma in its end stages. That the spinal fluid contained red cells and white cells, many of them lymphocytes instead of polymorphonuclear cells, makes me think this was not an abscess around the meninges but was probably more likely lymphoma — a malignant metastasis, if one can talk of the migration of lymphomas as metastases. The fact that it came on quite slowly and then manifested itself as a convulsion is also much more in favor of its being a lymphoma and leads me to choose this diagnosis rather than infection. I think that the patient had a lymphoma involving the meninges mostly on the right side over a widespread area affecting the facial nerve and infiltrating the motor area. Farther than that I cannot go.

Now what about the breast? She had something in the breast that was hard on the outside. Lymphoma in the breast is not rare. It does not sound like an abscess. I would guess, if anything, that it was lymphomatous involvement of the breast.

What about the kidneys? Why was there a ++ test for albumin and red cells and some white cells in the sediment? She had some infection, and I think the infection in the arm alone would justify such an effect on the kidney, with some possible infection in the kidney and possibly some cloudy swelling. The question arises in my mind in a case like this as always, Did the patient have a hypernephroma? Metastasis of hypernephroma to the brain occurs, but it is uncommon. I have no reason for making that diagnosis. I discard it. She may have had some lymphomatous lesion in the kidney. I would not be a bit surprised to see that.

In other words I would summarize this extremely difficult case by saying that I think the whole disease was essentially lymphoma — the diagnosis that Dr. Mallory gave us and that I accept with pleasure — complicated by infection, which while it was quite severe and accounted for some of the fever, was not the cause of the patient's death. The cause of death was, I think, lymphomatous involvement of the central nervous system.

DR. MALLORY: Are there any questions or comments?

DR. ALFRED E. KRANES: This bears a certain similarity to a case of subacute bacterial endocarditis that I discussed some time ago. I wonder about the possibility of subacute bacterial endocarditis with multiple emboli.

DR. WALTER BAUER: I feel very much the same as Dr. Kranes does. I do not see how one can rule out malignant endocarditis in this case. The setting was perfect. The physical examination does not help us at all. The record merely says that the thoracic, abdominal and other examinations were negative. But the patient had sepsis, a good source for endocarditis. I think it would explain everything that this woman exhibited and also would account for the renal abnormalities.

A PHYSICIAN: In the missing x-ray films were there any of the skull that might be useful to Dr. Aub in ascertaining whether there was bony involvement or involvement of the central nervous system?

DR. MALLORY: No; I think not. Dr. Record, have you any comment? Would you tell us the opinion held on the ward?

DR. EUGENE E. RECORD: This woman had a two-year history, and the tumor was thought to have involved the knee. Did you know that she had a two-year history?

DR. AUB: A duration of two years is not unusual for lymphoma, particularly of the bone.

DR. BAUER: Is not lymphoma sometimes primary in the bone?

DR. MALLORY: Reticulum-cell sarcoma, which this was in our opinion, not infrequently is, and five-year or ten-year cures following amputation are on record.

DR. AUB: Three or four years of life without amputation, too! The thing I cannot understand is why no x-ray treatment was given over the skull. Obviously, my diagnosis was not the diagnosis on the ward, or the patient would have been given x-ray therapy over the calvarium.

DR. ARTHUR S. PIER, JR.: I can give you the answer to that. Dr. Record asked me to see the patient before operation. I thought that she probably did have lymphoma in the skull that had invaded the right cortex, and x-ray films of the skull were taken and x-ray treatment considered. The x-ray examination was reported to be negative and she became so sick that nothing could be done. She had nothing in her heart that I could detect as I recall it.

DR. BAUER: Was chemotherapy or antibiotic therapy continued right up to the end?

DR. PIER: Yes.

DR. MALLORY: Dr. Sweet do you care to comment on the neurologic findings or symptoms?

DR. WILLIAM H. SWEET: I have only one minor comment, and that is that I would not have thought that with this course of events the right facial weakness necessarily suggests that the facial nerve itself was involved. The abrupt improvement in the patient's strength in the right side of the face described here leads me to think that the lesion involved the cortex controlling the right side of the face rather than the peripheral nerve.

DR. AUB: It was so very widespread!

DR. SWEET: The cortex on both sides was involved.

DR. AUB: Is it not characteristic of neoplasm? Such patients start off with sluggishness and then they may have convulsions, with temporary paralysis and later complete paralysis.

DR. SWEET: Yes; I do not see anything against a diagnosis of neoplasm here except the one point that left hemiplegia very abruptly developed. This was, I gather from this record, over the course of twenty-four hours. Now neoplasm can, of course, develop hemorrhage into it, but that would lead one to be suspicious of a purely vascular episode that might not be associated with neoplasm at all.

DR. BAUER: How does Dr. Aub explain the fever?

DR. AUB: You do not have to explain fever in lymphoma.

DR. BAUER: What about the white-cell count?

DR. AUB: This woman had a very severe infection. In advanced lymphoma one may find an elevated white-cell count with a very low lymphocyte count.

DR. BAUER: The bone marrow was involved, with 95 per cent neutrophils?

DR. AUB: This woman was very "seedy" because she had a lymphoma and fever of twenty-two months' duration that did not respond to any treatment.

DR. MALLORY: The infection in the arm apparently never cleared, I believe. Dr. Record, that is correct, is it not?

DR. RECORD: Yes, it is. The knee is interesting because it puzzled us when the patient came in. She gave a history of having had a swelling of the right knee to twice the normal size that had been present for almost three months. Then, for a period of a year and a half, she had no symptoms referable to the right knee at all. On examination there was slight swelling on the lateral aspect of the proximal tibia and marked instability.

DR. AUB: I think that is very puzzling. I cannot do better with this case than I have anyway.

CLINICAL DIAGNOSIS

Malignant lymphoma, clasmatocytic type, with widespread metastases, particularly cerebra metastases.

DR. AUB'S DIAGNOSES

Malignant lymphoma, clasmatocytic type, of arm and shoulder, and of right meninges and cerebral cortex.

Osteomyelitis of tumor area in arm and shoulder.

Infection and cloudy swelling of kidneys.

ANATOMICAL DIAGNOSES

(*Malignant lymphoma, clasmatocytic type, of arm.*)

Meningitis, diffuse, purulent (B. pyocyaneus).

Osteomyelitis, head of tibia, with septic arthritis.

Operation: amputation of right arm.

PATHOLOGICAL DISCUSSION

DR. MALLORY: I am afraid Dr. Aub was right in suspecting a Greek gift here. At the time of autopsy we were able to find no tumor in this patient except the remnants known to exist in the amputated arm. There were no distant metastases anywhere. The lesion in the central nervous system was a diffuse purulent meningitis, and cultures from that demonstrated *B. pyocyaneus*, which had been cultured from the amputation stump as well. The heart showed no endocarditis. We found no lesion of the kidney. The knee showed osteomyelitis of the head of the tibia, with considerable calcification in the coronary ligament of the knee joint and a slight synovitis, apparently terminal extension of infection into the knee joint. The terminal symptoms in this patient, I am sure, were all due to infection and not to tumor. The bone marrow presented a peculiar appearance, with a marked depression of red-cell formation, good maturation of the neutrophils and a scattering of immature cells, which I was quite certain were not tumor cells and represented early elements.

DR. BAUER: How do you account for the spinal fluid?

DR. MALLORY: I can only answer that on previous occasions we have seen extensive meningitis with a very small number of cells in the lumbar spinal fluid and nevertheless good response to jugular compression.

DR. BAUER: There was no block at autopsy?

DR. MALLORY: Block is a very difficult thing to determine at autopsy.

DR. BAUER: What about adhesions? One always has to consider them in meningitis. What was it like grossly?

DR. MALLORY: It was a diffuse purulent meningitis, without much fibrosis or organization.

DR. BAUER: Did she have any headaches at the end?

DR. PIER: It is difficult to make out. She was in a coma during the last few days. She spoke vaguely of having a little headache.

DR. AUB: I do not feel badly about being wrong!

DR. BAUER: Why should one ever feel badly about being wrong? One always learns from it.

DR. AUB: I should like to know very much, Dr. Record, if there was an osteomyelitis before the arm was first opened. Was pus found at the first incision of the elbow in the other hospital?

DR. RECORD: Yes; it was.

DR. AUB: Then this case falls into a category that Dr. Herman Hoster* described a few years ago of lymphoma developing in an area of chronic infection. That is quite interesting because obviously the tumor was primary in the arm, and if there was osteomyelitis there before incision that might have been the cause of tumor.

DR. MALLORY: We could not say from the pathological specimen whether the tumor preceded the osteomyelitis or vice versa.

*Hoster, H. A., et al. Studies in Hodgkin's syndrome. VI. Clinical and etiologic studies. *Ohio State M. J.* 43:721-724, 1947.

CASE 36392

PRESENTATION OF CASE

First admission. A forty-four-year-old man entered the hospital complaining of shortness of breath, insomnia, cough and pain in the chest.

Eight years before entry, following a bout of pneumonia, he began to have precordial pain on exertion that radiated to both arms. Ten months after the attack of pneumonia he had a severe episode of substernal, squeezing chest pain, followed by collapse and loss of consciousness for one and a half hours. Following this he was kept in bed for two weeks. Since that time he had had chest pain of two types, a substernal, pressing pain and a sharp precordial pain, both radiating to the left arm and shoulder and readily relieved by nitroglycerin or brandy. For five years prior to admission he had increasingly severe dyspnea, orthopnea and ankle edema. Seven days before entry the ankles and abdomen began to swell, and for the past four days he had had continuous angina pectoris.

The patient had had many infectious diseases: mumps, measles, chicken pox, whooping cough, typhoid fever, scarlet fever, viral pneumonia and bronchopneumonia with hemoptyses. He also had asthma and hay fever. He denied having rheumatic fever, nephritis or high blood pressure. An aunt stated, however, that he had been born with a "leaky valve." He was a runner at college, and physical examinations were always negative.

Physical examination revealed an extremely dyspneic, orthopneic man. There were basal bubbling, moist rales and dullness over both lung bases. The heart was enlarged with the left border 12 cm. from the midsternal line. There was a normal sinus rhythm at a rate of 120, with an accentuated pulmonic second sound. The heart sounds were of poor quality, with a protodiastolic gallop maximal just inside the right costal margin. The spleen was not felt. There were minimal ascites, mild sacral edema and a ++ edema from the ankles to the knees.

The blood pressure was 108 systolic, 82 diastolic.

Examination of the blood revealed a hemoglobin of 14 gm. and a white-cell count of 11,000, with 58 per cent neutrophils. A urinalysis was normal. The nonprotein nitrogen was 20 mg., the cholesterol 197 mg., the uric acid 6.4 mg., and the total protein 6.2 gm. per 100 cc. The sedimentation rate was 1.8 mm. per minute corrected. A Decholin circulation time was 25 seconds. The venous pressure was equivalent to 141 mm. of saline solution. Radiologic examination of the chest demonstrated considerable cardiac enlargement without characteristic configuration and prominent pulmonary congestion. An electrocardiogram showed a normal rate of 100, a PR interval equal to 0.16 second and a QRS interval equal to 0.08 second. The T-waves were upright in Leads AVL and V_1, V_2, V_3, V_4 and V_5, inverted in Lead AVR and flat in Lead AVF. There was left-axis deviation. The patient was given digitalis, mercurial diuretics, a low-sodium diet and nitroglycerin when necessary for chest pain. On this regime he lost 24 pounds and was discharged improved.

Final admission (one year later). He was followed at monthly intervals in the Medical Clinic. He maintained himself on a rigid program and was bedridden most of the day. His exercise-tolerance, however, continued to be almost nil, and he was extremely weak and dyspneic when out of bed. He had occasional attacks of paroxysmal nocturnal dyspnea, and his wife noted that the pulse was irregular, varying between 60 and 200 per minute. He continued to have precordial pain on exertion, with occasional numbness and tingling sensations in the left arm.

Nine months following the first admission he had a severe attack of precordial pain, which radiated down both arms and was not helped by nitroglycerin. This attack lasted twelve hours and was finally stopped with codeine. He had intermittent attacks of substernal pain following this, relieved only by codeine. He was seen in the Medical Clinic a month later, when an electrocardiogram was reported as showing no significant change since the last tracing. The patient was then given an exercise-tolerance test. He walked over the "Master" two steps fifty times without pain or discernible dyspnea, and the subsequent electrocardiogram showed no change. When the physician left the room, however, sharp precordial pain and subjective dyspnea developed. The patient was relatively well until two weeks before the present admission, when he developed a cold, followed by a cough, a temperature of 102°F. and increasing dyspnea. He began to produce a small amount of sputum, which was occasionally blood streaked. Whenever he produced sputum he became nauseated and finally became anorexic and vomited every-

thing that he took by mouth. The dyspnea increased, as did the coughing and bloody sputum. The abdomen began to swell, and he also complained of tenderness in the right upper quadrant and both calves.

Physical examination revealed a chronically and severely ill man, who was quite dyspneic and orthopneic. He found it an effort to talk and seemed to take some satisfaction in appearing wretched. The neck veins were distended and pulsating when the patient sat upright. There were a few rales at both lung bases with no dullness or friction rub. There was slight tenderness over the lowest rib in the left posterior axillary line. The heart was enlarged to the left anterior axillary line. There was a regular rate of 128 and an apical protodiastolic gallop. There were no murmurs, and the aortic second sound was less than the pulmonic. The abdomen was smooth and distended. The liver was tender and palpable five fingerbreadths below the right costal margin. There was a ++ edema of the leg. The calves were tender bilaterally, and there was tenderness along the course of the right femoral vein.

The temperature was 101°F., and the respirations 32. The blood pressure was 95 systolic, 65 diastolic.

Examination of the blood revealed a hemoglobin of 16 gm. and a white-cell count of 26,200, with 66 per cent neutrophils, 24 per cent lymphocytes and 10 per cent monocytes. A urinalysis revealed a specific gravity of 1.024, with a + albumin, and 4 to 5 red cells and 1 to 3 white cells per high-power field and many hyaline casts in the sediment. The nonprotein nitrogen was 106 mg., and the total protein 6.1 gm. per 100 cc., and the serum van den Bergh 1.8 mg. direct, 2.2 mg. total per 100 cc. The sodium was 117 milliequiv. per liter, and the prothrombin time 63 per cent. Radiologic examination of the chest (Fig. 1) revealed marked enlargement of the heart to the left and densities in both lower lobes that suggested infarctions.

The patient did not respond to mercurial diuretics. The dyspnea and edema increased. He was started on Dicumarol, and the prothrombin time dropped to 40 per cent of normal. On the second hospital day he coughed up 2 teaspoonfuls of bright-red blood. The urine output was 500 cc. On the morning of the third day he suddenly sat up and screamed, became cyanotic and pulseless, and died.

Differential Diagnosis

Dr. James H. Currens*: In essence this is the history of a forty-five-year-old man who had significant cardiac symptoms for nine years. It is interesting that on entry he had four symptoms, all of which could and probably did result from congestive circulatory failure. He had two types of pain; one was a substernal squeezing sensation that at times radiated to the upper arms. That certainly is quite characteristic of angina pectoris, and I shall accept it as evidence of angina pectoris. The other type, which was more marked on the left side of the chest, also radiated to the left arm and was said to be relieved by nitroglycerin and brandy. Often in patients with prolonged symptoms of heart disease, there is an element of anxiety, of fear, perhaps of undue consciousness of the heart and of fatigue so that pains that occur in the left side of the chest are difficult for the patient to differentiate from real angina pectoris. I suspect that the pain in the left chest was the result of anxiety and fatigue.

The age of thirty-six is certainly relatively young for symptomatic heart disease to develop in a man who gave no history of previous disease, such as rheumatic fever or hypertension, that might predispose to heart disease. It might be of interest to know the weight and height of this patient since men who develop coronary-artery disease with myocardial infarction before the age of forty are more likely to be short and heavy in body build — the so-called mesomorphic type.

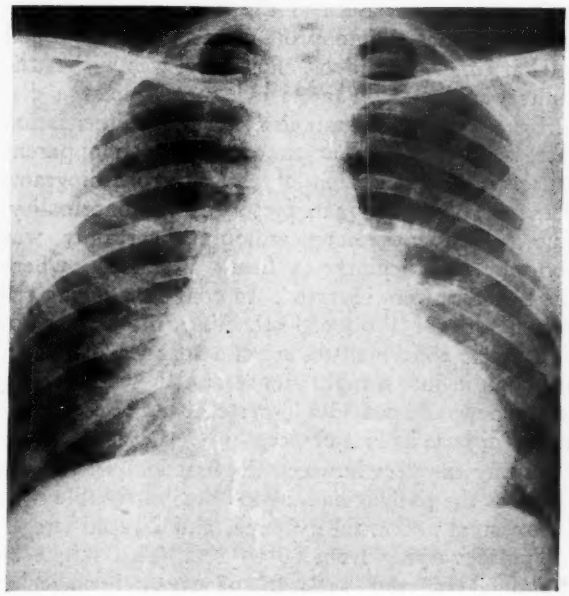

Figure 1.

Dr. Tracy B. Mallory: The patient was 175 cm. tall and had an estimated weight of 165 pounds. We have no exact weight.

Dr. Currens: That is about 5 feet, 10 inches. The height and weight were more or less average.

To return once again to the history, the patient developed signs of fluid retention and evidence of congestive circulatory failure. This was manifested by the orthopnea, the pulmonary congestion, the definite enlargement of the heart, the accentuation

*Assistant in medicine, Massachusetts General Hospital.

of the pulmonic second sound, indicating pulmonary hypertension, and a rather loud third sound, which was described as protodiastolic in time. The liver was significantly enlarged, and there was moderate edema. The one episode of collapse and loss of consciousness for one and a half hours I cannot adequately explain. It is unusual for patients with coronary-artery disease to suffer loss of consciousness at a time when severe substernal pain is present. A possible explanation is auriculoventricular block, with a very slow rate and insufficient cerebral circulation. No mention is made of convulsions, which usually accompany heart block of high degree. The reverse might be true — that is, the pulse might be very fast, and cerebral circulation also might be insufficient. The loss of consciousness was unusual, and I have no good explanation for it.

The laboratory data in the first admission were of note in that the nonprotein nitrogen was normal at that time. The blood cholesterol was within the limits of normal. That is evidence against a disturbance of fat metabolism. The sedimentation rate was rapid at that time without an apparent cause. The description of the electrocardiograms does not give an adequate picture of the abnormality. The subsequent electrocardiogram certainly was abnormal, particularly in Leads V_6 and V_6 where the T waves were inverted. In contrast, during the year before the T waves in the V_6 position were upright. The abnormalities are of a nonspecific nature, although in just a rapid glance at the electrocardiogram one would consider hypertensive and coronary-artery disease as first choice.

During the year between the first and second admissions the patient had a good deal of trouble with paroxysmal nocturnal dyspnea, and a rapid irregular pulse varying from 60 to 200. This might be explained on the basis of paroxysmal auricular fibrillation. Another possibility is auricular flutter with varyi g auriculoventricular block, which could account for the fluctuation from a slow or relatively normal rate up to a relatively rapid rate of 200. Three months before the second admission, there was a prolonged bout of substernal pain lasting twelve hours that was consistent with myocardial infarction. This was followed by intermittent pain. At that time an exercise-tolerance test was done. One might ask why an exercise-tolerance test was done in a man with as many symptoms as he had and with an abnormal electrocardiogram. I suppose it was done because the symptoms of chest pain were quite confusing, as is frequently so in these patients, and more objective evidence was needed to interpret the symptoms. Although the rate increased significantly to about 140 per minute in the electrocardiogram after the exercise test, the test was disappointing since no significant alteration of the ST segment or the T waves was noted. After the test the patient did develop chest pain. I should like to emphasize the importance of taking electrocardiograms at the time of pain. Recently, a patient was observed who presented a similar problem although the electrocardiogram was normal and no signs of heart disease were present. She also had a normal electrocardiogram after the exercise-tolerance test until she developed pain spontaneously several minutes later. The last two precordial leads recorded during the pain showed a significant abnormality.

A pulmonary embolism might easily explain the fever, cough and hemoptysis, which preceded the second entry to the hospital by two weeks. This was perhaps substantiated by the finding of tenderness in the region of the right femoral vein. The tenderness in the right upper quadrant was undoubtedly associated with some increase in the engorgement of the liver.

Perhaps Dr. Wyman would show us the x-ray films at this time.

Dr. Stanley M. Wyman: The original films show rather pronounced enlargement of the heart, chiefly toward the left and possibly in the region of the left ventricle, although that is rather difficult to determine. The hilar and pulmonary vascular shadows are definitely increased in prominence. Four days later the vascular markings in the lung fields are more nearly normal. There may be a little calcification in the aortic arch, but I am not certain of that. An interval film, taken about four months after the first two, shows the heart to be perhaps a little less enlarged, and the hilar and pulmonary vascular shadows are maintaining a relatively normal appearance, being only slightly increased in prominence. The films (Fig. 1) taken during the second admission show the heart to be still larger than originally and the hilar vessels to be more prominent. There are a few small linear shadows out in the peripheral lung fields that are highly suggestive of small infarcts. On the last set of films there is one shadow posteriorly in the left lung that suggests a rather sizable infarct. When the original films are compared with the later ones, there is some suggestion of decreased vascularity in the right-lower-lung field, but that is only a suggestion that I do not think can be taken too seriously.

Dr. Currens: The x-ray films demonstrate a significant enlargement of the heart, with mild congestive changes and findings that might be interpreted as pulmonary infarcts.

The kidneys were able to concentrate the urine fairly well in that the specific gravity was 1.024, but there were 4 to 5 red cells and 1 to 3 white cells per high-power field in the sediment. Such findings raise the possibility of infarction of the kidneys as a result of embolism. There was nitrogen retention and renal insufficiency at that time, and the sodium was lower than normal. One would like to know what the serum chloride and carbon dioxide were. There must have been a moderate degree of acidosis associated with the renal insufficiency.

The last note of interest in the protocol is the way in which the patient died. He sat up in bed, screamed and became cyanotic and pulseless. I would be rather surprised if that sequence of events was the result of pulmonary embolism because patients with pulmonary embolism do not have much pain or at least sudden pain of that nature. The fact that the patient screamed might indicate that he had pain at that time. Perhaps the cause of sudden death was the underlying heart disease.

As far as the etiology of the disease is concerned, one might consider syphilitic heart disease but not too seriously. There was no evidence of aortic regurgitation and no positive serologic test for syphilis. Also, patients with syphilitic heart disease seldom live more than two or three years after the onset of congestive circulatory failure. Hypertensive heart disease can be dismissed fairly easily. Occasionally, patients with significant enlargement of the heart and chronic failure have very little hypertension, but undoubtedly in such cases for several years preceding the cardiac insufficiency there has been a significant hypertension. Idiopathic hypertrophy of the heart is certainly to be considered.

My impression is that the symptoms were all characteristic of coronary-artery disease, coronary atherosclerosis and infarction of the heart muscle. In favor of such a diagnosis is the fact that he was a man. Coronary atherosclerosis in a woman of this age, without hypertension or a disturbance of fat metabolism, would be exceedingly rare. There is no other very evident etiology. Against such a diagnosis is the absence of hypertension, the absence of any diabetes mellitus or faulty metabolism of fat and a nonspecific electrocardiogram. There is a certain group of men with extensive coronary-artery disease and infarction of the heart without clear evidence of myocardial infarction in the electrocardiogram. I would therefore account for the symptoms on the basis of coronary atherosclerosis, myocardial infarction and pulmonary embolism, with infarction. I doubt that he had a terminal pulmonary embolism. I should not be surprised if Dr. Mallory demonstrates embolism to the kidneys to account for the renal insufficiency and the red cells in the urine.

DR. EDWARD F. BLAND: Is it not almost axiomatic, Dr. Mallory, that the patients you see who have hearts as large as this on the basis of coronary-artery disease alone have multiple or extensive myocardial infarcts in the absence of hypertension?

DR. MALLORY: I agree.

DR. BLAND: As Dr. Currens said, these electrocardiograms are very disappointing. If the patient had multiple infarcts in the heart, one might more or less balance the other in the electrocardiogram, but they are still extremely disappointing.

CLINICAL DIAGNOSES

Arteriosclerotic heart disease.
Congestive failure.
Pulmonary embolism.
?Myocardial infarction.

DR. CURRENS'S DIAGNOSES

Coronary-artery disease.
Coronary atherosclerosis, with myocardial infarction.
Emboli, pulmonary and ?renal.

ANATOMICAL DIAGNOSES

Coronary sclerosis, with occlusion, severe.
Myocardial infarct, old.
Pulmonary embolism and infarction, multiple.
Renal infarcts.

PATHOLOGICAL DISCUSSION

DR. MALLORY: Autopsy showed very extensive coronary-artery disease — the right coronary artery was completely blocked by an old spot of calcification, and there were similar areas in both the circumflex and descending branches of the left coronary artery. There was a very large area of fibrosis in the myocardium, evidently an old infarct involving a large portion of the left ventricle and the left interventricular septum. The mitral and aortic valves showed a little calcification, which we considered to be essentially on a sclerotic basis. The heart itself weighed 520 gm. and was markedly dilated. The pulmonary arteries were rather surprisingly atheromatous for a case of coronary-artery disease. They looked very much like one of mitral stenosis, but the right ventricle was not hypertrophied.

Just as Dr. Currens predicted, there were infarcts of the kidneys. One small one was found in each kidney. The lungs showed four pulmonary infarcts of varying age, but none of them were extremely fresh. There were four separate emboli to account for them, and there was no terminal pulmonary embolism.

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A WAY OF LIFE

Constant repetition of the declaration that American medicine is the best in the world has brought this cliché to the point where its danger as a soporific agent must be weighed against its possible value as a source of information. The statement is undoubtedly true, but it is also misleading. American medicine as it is practiced in a university hospital by the staff of a first-class medical school can hardly be matched, and the average quality of American medicine is probably superior to what can be found in virtually any other country in the world.

The unavoidable implication, however, that American medicine is nearly as good as is presently possible is unwarranted in view of the level that it might attain with reasonable use of the medical knowledge available. As it is, only relatively few people benefit from the best medical care in the world and the general quality of medical service delivered varies as the capacity and the desire of average human beings to deliver it must vary. How many shepherds are content to graze their flocks in barren pastures with green slopes so easily attainable!

These are the points that have been brought out in the August issue of *The Atlantic Monthly* by Dr. Caleb Smith, now assistant professor of surgery at the University of Rochester School of Medicine, who, as a well trained young surgeon, entered practice in a small town.

Among the dangers that the general practitioner runs, according to Dr. Smith, are the attempt to do too much for too many people, often with a training that cannot possibly cover all that is expected of him; and the desire or the necessity of making money — a universal and very human incentive. His chief danger, however, lies in abandoning careful study and diagnosis in favor of the quicker, easier treatment of symptoms. Once he has forsaken the first for the second he has let himself be drawn into a vicious circle from which he can hardly extricate himself. He has entered the wheel of the squirrel cage that he must turn from that time on. For engagement in the practice of symptomatic treatment is actually the desertion of the science and the art and often of the finer ethical standards of medicine; it is open to ludicrous errors and too often fraught with tragic mistakes.

There are obvious remedies for the present inadequacies of family practice as it is conducted by a still too great percentage of its followers. They must simply be applied in greater measure and there should be no bragging about the quality of American medicine while there is still so much room for improvement.

The first of these remedies is that well trained young men must be induced to settle in small communities, among the inducements being the assurance of fair conditions of competition, and adequate facilities, intelligently administered, for doing the highest grade of work. Hospital executives and trustees, therefore, must be drawn into this co-operative effort.

Opportunities and encouragement for constant improvement must also be given to the general practitioner through adequate consultation service and accessible postgraduate instruction, such as is being offered in this state. In this respect the American Academy of General Practice in three short years has become one of the most useful and important medical organizations in the country.

When these opportunities are fully exploited family practice will become for many what it has always been for a few — not only a dignified and adequately remunerated professional pursuit but a complete and satisfying way of life. American medicine may then be not only the best in the world, but equal to its own potentialities.

THE ARMY HOSPITAL

An important change in the organization of Army hospitals is described in a recent issue of the *United States Armed Forces Medical Journal*.* In the future, well qualified and highly trained staffs in the clinical specialties will be assigned to station as well as general hospitals. This move indicates that the base of professional competence within the Army Medical Corps has been greatly broadened. Simple as it seems, it will be welcomed by all who have been interested in the development of the highest professional standards within the armed forces.

The distinction between station and general hospitals has been most unfortunate. It arose partly because of a shortage of trained personnel and partly because of the exigencies imposed by the need, even in peacetime, for the evacuation to larger centers of patients with long-term illnesses. But, over the years, station hospitals became identified with limited if not inadequate care, whereas general hospitals became representative of the best in medical and surgical practice. The entrance into the service during World War II of many crack university units as general hospitals did much to accentuate this misconception. Indeed, any medical officer of experience can recall seriously ill patients who were transported long distances to the "good" general hospital rather than risk hospitalization in the "poor" station hospital. This attitude compounded many times had its deleterious effect upon morale within the station hospital and upon the troops serviced by them.

Despite the low regard in which station hospitals were apt to be held, many of them established the most outstanding and enviable records. Given an adequate and well trained staff, station hospitals were quick to gain the confidence, admiration and affection of the troops. The word "affection" is used deliberately because the mission of a station hospital, the care of men on their own post, is ideally suited for the development of the best in patient-doctor relationship. As Colonel Bowers points out in the article referred to above, if the station hospital provides competent, well balanced care, it can be likened to group practice, provided in the patient's home atmosphere, his own post, rather than in a general hospital that may be hundreds of miles away. Moreover, there is no medical unit in the Army that can compare with the station hospital in the variety of acute and chronic diseases that fill its wards. Well run, with a balanced table of organization permitting adequate promotion, the station hospital is the perfect place for the young, fully competent staff to practice the art of medicine and surgery.

It is hoped not only that this proposed plan will be seen to completion but also that, as the number of well trained specialists within the armed forces increases, the distinction between hospitals will be designated merely by numbers that signify size and mobility. The precise mission of an army hospital may vary with the tactical situation, but it always remains the skilled and competent care of the sick.

*Bowers, W. F. Station hospital as diagnostic and treatment center. *U. S. Armed Forces M. J.* 1:827, 1950.

SPIRIT OF '76

Women physicians, dentists and allied specialists desirous of active service in the Army or in the Air Force may now be assigned commissions in the Reserve Corps, in grades from first lieutenant to colonel, according to recent releases from the Office of the Surgeon General of the Army, and the Department of Defense. Under the new authorization these officers may then volunteer for active duty,

in which case they will be eligible for service in every type of military medical facility, with the exception of forward medical installations in combat zones. This decision is at least partly the result of numerous applications received from women physicians during the past year.

A number of women doctors served in the Army during World War II but were separated from active duty in 1947, when the legislation permitting their commissioning expired. Two years later a bill providing for the commissioning of women physicians in the Regular Army and Regular Air Force was introduced to Congress and passed the House in June, 1949. Senate hearings have been held and a special committee is at present studying the practicability of extending the proposed legislation to make it cover all three services.

In the Navy women physicians continue to serve only as WAVES, with rank limited to that of lieutenant commander, as with all WAVE officers.

It is encouraging to learn that women, with their record for getting things done, are being permitted to take a larger part in the more urgent affairs of the nation.

SEVENTY–FIFTH ANNIVERSARY

THE attention of the fellows of the Massachusetts Medical Society, all members of the Boston Medical Library by virtue of a slight deduction from their dues, is directed to an invitation emanating from the Library and published in this issue of the *Journal*.

On October 18 this institution, so impressively valuable to medicine in all its branches, will sponsor a dinner in celebration of the seventy-fifth anniversary of its founding, and, incidentally, the fiftieth of the present structure that houses it, the foundation of which was laid in 1900.

The speaker of the evening will be Chauncey D. Leake, Ph.D., executive vice-president and dean in charge of the medical program of the University of Texas. An interesting as well as an instructive evening is assured.

The Massachusetts Medical Society members of the Library are urged to subscribe in large numbers to this dinner. Its cost, at $4.50, is trifling, amounting to little more than $2.25 when converted into the real, or pre-recovery value of the dollar, and seems still more trifling when viewed in the light of things probably about to come.

1951 PRIZE–ESSAY COMPETITION

As PREVIOUSLY announced* the *Journal* is again conducting its prize-essay competition, open to all members of the class of 1951 registered in any medical school approved by the Council on Medical Education and Hospitals of the American Medical Association. Attention is called to the change in the rules whereby the essay for 1951 is to consist of a case personally studied by the student, in combination with a discussion of the pathologic condition represented by the case and a review of the literature, the paper following, in general, the form of case reports previously published in the *Journal*. The other rules of the contest are as follows:

Manuscripts are to be not more than five thousand words in length, clearly typewritten in English, double or triple spaced with references listed at the end in numerical arrangement according to the form used by the *Quarterly Cumulative Index Medicus*. They must be in the hands of the editor by March 15, 1951, and must be accompanied by a certification from the dean of the medical school concerned stating that the author is a member in good standing of the fourth-year class and specifying the expected date of graduation. All manuscripts will become the property of the *Journal*.

A cash prize of $100 will be paid for the best essay of those found to be suitable for consideration; the paper will be published in the *Journal* if the quality is considered to conform to the standards by which the editors judge material submitted, and the author will receive a hundred free reprints.

A second prize will consist of a two-year subscription to the *Journal*.

The editors wish to emphasize that in establishing this competition they are as much interested in encouraging good medical writing as they are in promoting the collection of scientific material. In judging papers that may be submitted, particular attention will accordingly be paid to clarity, simplicity and general literary excellence.

*Editorial. Prize essay. *New Eng. J. Med.* **242**:919, 1950.

The Spanish Journals narrate the case of a man, aged 70, born at Majorca, of sanguine and apoplectic temperament, who, according to an approximate calculation, has, during a period of fifty-five years, been two thousand times bled at the arm, and on each occasion at least a pound of blood has been abstracted.

Boston M. & S. J., *Sept. 25, 1850*

MASSACHUSETTS MEDICAL SOCIETY

DEATHS

BRADY — Joseph E. Brady, M.D., of Brockton, died on August 27. He was in his seventy-first year.

Dr. Brady received his degree from Yale University School of Medicine in 1906. He was a fellow of the American Medical Association.

His widow, a niece and a nephew survive.

MORRISON — L. Raymond Morrison, M.D., of Boston, died on August 12. He was in his fifty-third year.

Dr. Morrison received his degree from Tufts College Medical School in 1924. He was an associate in neuropathology at Harvard Medical School and neuropathologist at Massachusetts General Hospital and was a member of the American Association of Neuropathologists and American Association of Pathologists and Bacteriologists and a fellow of the American Medical Association.

His widow, a son and a daughter survive.

SCHOFIELD — Roger W. Schofield, M.D., of Worcester, died on August 22. He was in his sixty-second year.

Dr. Schofield received his degree from Harvard Medical School in 1914. He was a member of the staff of Worcester City Hospital and a fellow of the American Medical Association.

A brother survives.

BOSTON MEDICAL LIBRARY

ANNIVERSARY DINNER

The Massachusetts Medical Society members and their guests are cordially invited to attend the seventy-fifth anniversary dinner of the Library to be held at the Hotel Kenmore, Boston, at 6:30 on the evening of October 18.

The speaker of the evening will be Chauncey D. Leake, Ph.D., executive vice-president and dean in charge of the medical program of the University of Texas.

Dress will be optional.

Applications for tickets at $4.50 each should be received at the Library, 8 Fenway, not later than October 11.

CORRESPONDENCE

STATUS OF RESERVE OFFICERS

To the Editor: The Involuntary Recall Program of the Department of the Army has already called to active duty, with or without their consent, several officers of the Inactive Medical Corps of the ORC. It does not require prophetic vision to predict that further calls will be made as mobilization increases in scope and tempo.

Enlightened self-interest should dictate to the intelligent doctor veteran of World War II the advisability of examining his own position if such a call should reach him. This communication is not designed to tell him how to escape service; if called, he can escape only by virtue of being found physically unfit, or by instituting "through channels" a request for delay, which may or may not be accepted by higher authority. It is designed to tell many doctor veterans how to improve their situation if the call should come.

Most civilian doctors who served in World War II entered the service as reservists on extended active duty initially, or later by direct commission in the Army of the United States. If they achieved promotion they were promoted only in the AUS, and not in the ORC. Thus Joseph Doakes, M.D., now a successful surgeon, internist or other medical specialist, entered service in 1942, as a captain, ORC. On separation from active duty he was a lieutenant colonel, AUS. He was asked at that time if he cared to accept a commission in the ORC at the highest grade attained while in service. He did not choose to do so. He has received military communications since addressed to Captain Joseph Doakes, MC-Res., and has consigned most of them to the wastebasket.

It is evident that Dr. Doakes can legally be called to active duty at any time. If he is called now it will be as a captain. He can, however, as of this date (September 14, 1950) still accept a commission as lieutenant colonel, MC-USAR. True, he will be expected to be an active reservist and to accept assignment to an ORC unit, and equally true, he will not escape the possibility of being called to duty; nevertheless while medical officers assigned to reserve units that have not been alerted will not be delayed from this call solely by reason of such assignments, the policy of the Army, to date at least, has been to maintain units intact and on a reserve status until it is necessary to call the unit as a whole. In any event, if he has accepted an ORC commission as lieutenant colonel, Dr. Doakes will be called to duty in that grade.

I am writing this letter, not as a mouthpiece of official or continuing Army policy, but merely as an active reservist who has been following the development of mobilization with close attention. My statements are true to the best of my knowledge and belief. How official policy may have changed before this letter is published cannot be foretold; nevertheless as of this date I recommend that Dr. Doakes seek a commission in the ORC without delay.

THOMAS R. GOETHALS, M.D.

Boston, Massachusetts

EMBOLIC NEPHRITIS AND GLOMERULONEPHRITIS

To the Editor: In the article "Therapeutic Experiences with Subacute Bacterial Endocarditis" in the August 17 issue of the *Journal* Littmann and Schaaf state, "Renal failure, the result of embolic nephritis, was seen in 3 fatal cases." This statement bears amplification.

However, I should like to call to your attention the article of Baehr entitled "The Significance of the Embolic Glomerular Lesions of Subacute Streptococcus Endocarditis." (*Arch. Int. Med.* *27*:262-264, 1921), who states that "the intercurrent appearance of symptoms of renal insufficiency in a case of subacute streptococcus endocarditis is not to be ascribed to the embolic glomerular lesions." Bell, in his book, *Renal Disease*, published in 1947, states that the "embolic lesions are rarely extensive enough to produce renal insufficiency." And in Libman's early series of 800 cases of subacute bacterial endocarditis, not one case of renal insufficiency was found in association with embolic glomerulonephritis.

In the cases in which renal insufficiency is found it is usually due to intercurrent diffuse glomerulonephritis or, more rarely, renal infarction.

HERBERT M. PERR, M.D.

Rockville Centre, New York

Dr. Perr's letter was referred to Dr. David Littmann, whose reply was as follows:

To the Editor: Thank you for the opportunity of replying to Dr. Perr's letter. I am grateful to him for pointing out a discrepancy resulting from an oversight during preparation of the manuscript.

The sentence originally read: "Renal failure, the result of embolic nephritis and glomerulonephritis, was seen in 3 fatal cases." Somewhere between the original and final drafts, two words were inadvertently omitted, and their absence was not noted until brought to our attention by Dr. Perr.

DAVID LITTMANN, M.D.

West Roxbury, Massachusetts

BOOK REVIEW

The Cook Book for Low Sodium Diet. By Reena Roberts Hasker, M.A. 55 pp. Boston: Massachusetts Heart Association, Inc., 1950.

Here is help for the person who cooks the meals for the patient who has been put on a restricted sodium diet by his physician.

There has been a long-felt need for an attractive low-sodium regimen, particularly one that is reasonably adaptable to the needs of the entire family. Mrs. Hasker has produced menus, meal plans and recipes that will make it possible for the housewife to cook one meal suitable for the dieter and the nondieter. The addition of salt at the table for the nondieters makes the difference.

The book was inspired by an actual case. The wife said "Look at him — (the patient) — all he has to do is eat the stuff. I've got to cook it. It will drive *me* into nervous prostration!"

Now "the stuff" need not be bland and tasteless. Here is ample proof that the low-sodium diet is not a compromise with good eating. A single chart lists things to avoid for three levels of sodium restrictions. The rest of the book tells what one can eat — and enjoy the best.

There is heavy reliance on the most modern trend in cookery — the use of garden herbs for bringing out the flavors.

One of the physician members of the Massachusetts Heart Association Committee on Patient Acceptance of Low Sodium Diet described the book as "mouth-watering." Another said it is "practical, certainly follows nutritional principles and it is written in a pleasant style." Still another — going all out for it said, "It almost makes me wish I were on the diet so I could have such delicious food!"

In more serious mood, a Boston cardiologist wrote, "This is a valuable and practical contribution to the management of cardiacs."

Sample copies have been sent to all physicians in the Commonwealth who are likely to have need for it. Ample supplies have been sent to clinics. Additional copies for patients may be had free of charge by the mailing of a prescription blank with the name and address of the patient plainly inscribed, and signed by the physician.

The book is not for sale in Massachusetts and may be obtained only through one's physician, the Executive Committee of the Massachusetts Heart Association considering this part payment for the generous public support of its annual fund-raising effort.

BOOKS RECEIVED

The receipt of the following books is acknowledged, and this listing must be regarded as a sufficient return for the courtesy of the sender. Books that appear to be of particular interest will be reviewed as space permits. Additional information in regard to all listed books will be gladly furnished on request.

An Introduction to the Study of Experimental Medicine. By Claude Bernard. Translated by Henry C. Greene, M.A. With an introduction by Lawrence J. Henderson, professor of biologic chemistry, Harvard University. 8°, cloth, 226 pp. New York: Henry Schuman, Incorporated, 1949. $3.00.

The classic essay of Claude Bernard is again made available at a price within the reach of anyone. The present volume is a reprint of the exhausted edition of 1927. Bernard, the famous French experimental physiologist, published his epoch-making work in 1865.

Eating Together: A cookbook for diabetics and their families. By Camille Macaulay. With a foreword by Solomon Strouse, M.D., clinical professor of medicine, University of Southern California, attending physician, Los Angeles County General Hospital, and consultant (diabetes), Cedars of Lebanon Hospital. 8°, cloth, 419 pp. New York: Farrar, Straus and Company, 1950. $3.50.

Mrs. Macaulay has written this book from the experience gained as a housewife who was faced with the problem of preparing meals for a family of 5, including 2 diabetic patients, 1 child and 1 adult. She has succeeded in devising menus suitable for the whole family, including the diabetic patients. The text is divided into two parts: special experience; and menus and supplemental material. A table of food values and an index conclude the text. The book has the approval of the highest authority on diabetes. It is suitable for public libraries and the popular section in medical libraries.

Hormones in Clinical Practice. By H. E. Nieburgs, M.D., research associate, Department of Endocrinology, and assistant professor, Department of Oncology, University of Georgia School of Medicine. 8°, cloth, 388 pp., with 57 illustrations. New York: Paul B. Hoeber, Incorporated 1950. $5.50.

This special book covers the whole field of practical endocrinology and surveys the pertinent existing literature. Special chapters are devoted to the various hormones, insulin, the estrogens, progestogens and androgens, the thymus and pineal glands, psychosomatic endocrinology, nonhormonal substances for the treatment of endocrine disorders, vitamin-endocrine relations and diagnostic procedures. The last chapter furnishes a list of commercial preparations. Extensive bibliographies are appended to the various chapters, and there is a good index. The printing was done in Great Britain.

A Synopsis of Obstetrics and Gynaecology. By Aleck W. Bourne, M.A., M.B., B. Ch. (Camb.), F.R.C.S. (Eng.), F.R.C.O.G., consulting obstetric surgeon, Queen Charlotte's Hospital, London, obstetric surgeon, St. Mary's Hospital, London, and consulting surgeon, Samaritan Hospital for Women. Tenth edition. 12°, cloth, 522 pp., with 167 illustrations. Baltimore: Williams and Wilkins Company, 1949. $4.50.

The first edition of this manual was published in 1913, and the ninth edition in 1945. The text for the tenth edition has been revised and brought up to date. The chapter on the development of the early ovum has been rewritten and newly illustrated. The printing was done in Great Britain, and the publishing is good. The publication history of the synopsis speaks well for its soundness and popularity.

A Story of Nutritional Research: The effect of some dietary factors on bones and the nervous system. By Sir Edward Mellanby, G. B. E., M.D., Sc.D., F.R.S., secretary of the British Medical Research Council, and chairman, International Technical Commission on Nutrition. 8°, cloth, 454 pp., with 73 illustrations and 39 tables. Baltimore: Published for Vanderbilt University by Williams and Wilkins Company, 1950. $5.00.

This volume presents the Abraham Flexner lectures of the School of Medicine of Vanderbilt University, summarizing the author's experience of over twenty-five years of research in the field of nutrition and deficiency diseases. The text is divided into two parts: vitamin A deficiency and inco-ordination of movement, and the anticalcifying or rachitogenic action of cereals. Both parts have extensive bibliographies. There are author and subject indexes. The special monograph should be in all medical libraries.

The Premature Baby. By V. Mary Crosse, O.B.E., M.D. (London), D.P.H., M.M.S.A., D.(Obstet.) R.C.O.G., full-time officer, Birmingham Regional Hospital Board, medical officer in charge of Canwell Hall Babies Hospital, pediatrician in charge of Newborn Nurseries and Premature Baby Units at Sorrento, Heathfield Rd., Lordswood and Marston Green Maternity Homes, lecturer in child health, University of Birmingham, and lecturer in pediatrics, Central Midwives Board. With a foreword by Sir Leonard G. Parsons, M.D., F.R.C.P., F.R.C.O.G., F.R.S. Second edition. 8°, cloth, 167 pp., with 14 illustrations. Philadelphia: Blakiston Company, 1950. $2.75.

In this second edition a manual first published in 1945 has been thoroughly revised. Material on epidemic diarrhea, hemorrhagic and hemolytic diseases has been added. The section on treatment by penicillin has been brought up to date. Data on umbilical and scalp-vein transfusions have been included, and an easy method of calculating blood requirements is given. The use of "packed cells" and replacement transfusion is discussed. The chapter on feeding has been thoroughly revised, and the statistics have been brought up to date. There is a good index. The printing was done in Great Britain; the small volume is well published.

This Is Race: An anthology selected from the international literature on the races of man. Selected, edited, and with an introduction by Earl W. Count, Hamilton College. 8°, cloth, 747 pp. New York: Henry Schuman, 1950. $7.50.

This anthology covers the period from Comte de Buffon (1749) to S. L. Washburn, in the twentieth century, after World War I. The publishing is good, and because of the use of a light, soft paper the book is not heavy despite its size.

L'Organisation des os. By P. Lacroix, professor, Faculté de Médecine de Louvain. 8°, paper, 230 pp., with 87 illustrations. Paris: Masson et Cie, 1949. 900 francs.

This monograph on osteogenesis is well written, and the material is well arranged. The literature is surveyed, and the author presents the results of his experiments on the grafting of bony tissue, cartilage and periosteum in rats and rabbits. The text, which is illustrated with a large number of reproductions of microscopical slides, concludes with an extensive bibliography and an index of subjects. The publishing is excellent. The type used is especially good. This beautiful monograph should be available to all persons interested in the physiology and surgery of bones.

Bibliography of Occupational Medicine. Vol. I, 1948. 8°, paper, 93 pp. Geneva: International Labor Office, 1949. $1.00. Distributed by International Labor Office, Washington Branch.

In this new bibliography on industrial medicine, the subject is broken down into a number of classifications. The titles of the articles are given in the original language, and where unusual languages appear a translation is given. There are indexes of subjects and authors. It is recommended for all medical libraries and to all persons interested in the subject.

Menstruation and Its Disorders: Proceedings of the conference held under the auspices of The National Committee on Maternal Health. Edited by Earl T. Engle. 8°, cloth, 358 pp., with 105 illustrations. Springfield, Illinois: Charles C Thomas, 1950. $6.50.

The proceedings of a conference on menstruation, held under the auspices of The National Committee on Maternal Health, are presented in this volume. Papers were read by 19 authorities on the various subjects. Lists of references are appended to the various chapters; the printing is good. The lack of an index detracts from the reference value of the volume. The date of the conference should have been printed on the title page. The book is recommended for all medical libraries and all persons interested in the subject.

Medical Gynecology. By James C. Janney, M.D., associate professor of gynecology, Boston University School of Medicine, and associate visiting gynecologist, Massachusetts Memorial Hospitals. Second edition. 8°, cloth, 454 pp., with 108 illustrations. Philadelphia: W. B. Saunders Company, 1950. $6.50.

This book, first published in 1945, has been revised and brought up to date. Material has been added, including two new chapters on metrorrhagia and culdoscopy. Penicillin therapy is discussed in detail, and the use of the sulfonamides is evaluated in the light of present-day knowledge. The treatment of premenstrual tension and new tests, like the Papanicolaou smear test, and the modifications of pregnancy tests are included. Added is a detailed discussion of the medical and legal problems of artificial insemination and therapeutic abortion in cases of rubella. Emphasis is placed on the natural progression from the patient's complaints to correct diagnosis and treatment. The book is well published and should be in all collections on gynecology and in the libraries of gynecologists.

Lord Lister: His life and doctrine. By Douglas Guthrie, M.D. 8°, cloth, 128 pp., with 20 plates. Baltimore: Williams and Wilkins Company, 1949. $3.50.

This short life of Joseph Lister, written over eighty years after the discovery of the antiseptic method and the Lister spray, attempts to evaluate his achievement in the light of modern knowledge. New data on his life that have recently become available have been incorporated in the appropriate places in the text. The printing was done in Great Britain; the publishing is excellent.

If You Have a Deaf Child: A collection of helpful hints to mothers of deaf children. 8°, paper, 134 pp. Urbana: Published for the Illinois Annual School for Mothers of Deaf Children, by the University of Illinois Press, 1949. (No price; copies may be obtained from the Division of Services for Crippled Children, 1105 South Sixth Street, Springfield, Illinois.)

This helpful manual is the outgrowth of a group program for mothers of deaf children that was held in 1945, and has developed into an annual short-term school. Ten persons interested in the training of normal and deaf children have contributed to the manual. The text is divided into three main parts: the training of children in general; the training of deaf children; and schools, agencies and publications. The publishing is well done. The small volume should be in all collections on deafness.

Bowery to Bellevue: The story of New York's first woman ambulance surgeon. By Emily D. Barringer, M.D. 8°, cloth, 262 pp. New York: W. W. Norton and Company, Incorporated, 1950. $3.00.

In this interesting story, Dr. Barringer tells of her appointment in 1902 to the staff of the Gouverneur Hospital, the downtown branch of the Bellevue Hospital in New York City, and how she rode the ambulance through the East Side slums. Internships in that hospital were reserved for men only, and the appointment of Dr. Barringer was resented, but despite all difficulties, during her two years of internship, she became successively house surgeon and house physician, the last position automatically making her chief of staff. The text is well written in a narrative form, and the book is well published and should find a place in collections on medical history.

Medical Management of Gastrointestinal Disorders. By Garnett Cheney, M.D., clinical professor of medicine, Stanford University School of Medicine. 8°, cloth, 478 pp., with 29 illustrations. Chicago: Year Book Publishers, Incorporated, 1950. $6.75.

This practical book is devoted to diagnosis and medical treatment, especially office diagnosis. The text is divided into two main parts: the patient approach, discussing diagnosis in general and the various special procedures; and symptom diagnosis and treatment, in which twenty-five symptoms and conditions are discussed, with emphasis on treatment. Only the more up-to-date therapeutic procedures, proved satisfactory by the author during twenty-five years of practice, are presented. There is a good index, and the type and printing are excellent. The concise volume should prove valuable to physicians interested in the common diseases of the digestive tract.

Medicine for Nurses. By W. Gordon Sears, M.D. (Lond.), M.R.C.P. (Lond.), senior physician and superintendent, Mile End Hospital, London, and examiner to the General Nursing Council for England and Wales. Fifth edition. 12°, cloth, 472 pp., with 67 illustrations. Baltimore: Williams and Wilkins Company, 1949. $3.00.

This manual for nurses by a British author was first written in 1935. Material has been added in various sections, especially on the epilepsies. The author has also written two companion books for nurses on materia medica and on anatomy and physiology. The small volume is very well published. The printing was done in Great Britain.

A History of Biology: A general introduction to the study of living things. By Charles Singer. 8°, cloth, 579 pp., with 194 illustrations. New York: Henry Schuman, 1950. $5.00.

This standard reference work, long out of print, has been revised and brought up to date since the publication of the first edition in 1931. The publishing is good, and the price is reasonable. The volume is essential for all libraries—public, medical and college.

Bridges' Food and Beverage Analyses. By Marjorie R. Mattice, Sc.M., assistant professor of biochemistry, Graduate School of Medicine, College of Medical Evangelists, Los Angeles. Third edition. 8°, cloth, 412 pp., with 61 illustrations. Philadelphia: Lea and Febiger, 1950. $5.50.

This standard reference book has been thoroughly revised, and the material brought up to date. Approximately half the text consists of tables designed to aid in the evaluation of the constitution of foods. The section on the vitamins has been enlarged and revised. Material on goitrogenic foods has been added, and the mineral section now contains sodium and potassium analyses on about 500 foods and 150 municipal water supplies. The book is well published and is recommended to all nutritionists and all public and medical libraries.

Occupational Therapy: Principles and practice. Edited by William R. Dunton, Jr., M.D., founder and former editor, *Occupational Therapy and Rehabilitation*; and Sidney Licht, M.D., editor, *Occupational Therapy and Rehabilitation.* 8°, cloth, 321 pp. Springfield, Illinois: Charles C Thomas, 1950. $6.00.

In this composite volume, written by eleven specialists, the field of occupational therapy is well covered. A short history of the subject precedes the text, followed by chapters on the principles, the prescription, including hobbies and suggestions for the use of crafts in functional restoration, its use in psychiatric disorders, kinetic occupational therapy, occupational therapy for patients with amputations, occupational capacity and therapy in heart disease (by Dr. Paul D. White) occupational therapy in tuberculosis, in the treatment of cerebral palsy, education for hospitalized patients, bibliotherapy in neuropsychiatry, recreational therapy and drama therapy. Lists of references are appended to the chapters, and there is a good index. The book is recommended for all medical libraries and to all persons interested in the subject.

NOTICES

ANNOUNCEMENT

Dr. David Zelig announces the removal of his office to 356 Main Street, Haverhill.

SPRINGFIELD ACADEMY OF MEDICINE

The monthly meetings of the Springfield Academy of Medicine will be held in the Woman's Club Building, 43 Spring Street, on the second Tuesday of each month at 8:30 p.m. The speaker of the October 10 meeting will be Harry Greene, M.D., professor of pathology, Yale University School of Medicine.

SOUTH END MEDICAL CLUB

A meeting of the South End Medical Club will be held at the headquarters of the Boston Tuberculosis Association, 554 Columbus Avenue, Boston, on Tuesday, October 17, at 12 noon.

Dr. Lewis M. Hurxthal, head of the Department of Internal Medicine at the Lahey Clinic, will speak on the subject "Electrocardiography."

All physicians are cordially invited to attend.

MASSACHUSETTS SOCIETY OF ANESTHESIOLOGY

The annual Postgraduate Course of the Massachusetts Society of Anesthesiology will begin on October 7 at 2:30 p.m. in the Bigelow Amphitheater of the Massachusetts General Hospital. Dr. Leo Hand, New England Deaconess Hospital, will be chairman.

The topic will be "Pitfalls in Clinical Anesthesia" as related to neurosurgery, thoracic surgery, general surgery and obstetrics. A discussion period will follow. All interested physicians are urged to bring problems and questions for discussion. A registration fee of $5 will be charged.

Information may be obtained from M. Gene Black, M.D., Holyoke Hospital, Holyoke, Massachusetts.

NEW ENGLAND SOCIETY OF ANESTHESIOLOGISTS

At a recent meeting of the executive committee of the New England Society of Anesthesiologists, the program for the ensuing year was changed from eight to four meetings for the year. The date and city of these meetings will be as follows: November 14, 1950, Boston; February 13, 1951, Providence, Rhode Island; April 10, 1951, Hartford, Connecticut; and May 8, 1951 (annual meeting), Boston. The programs for each meeting will be announced later.

The first regular meeting of the Society for 1950-51 will be held in the amphitheater of Boston University School of Medicine, 80 East Concord Street, Boston, on Tuesday November 14, 1950, at 7:30 p.m.

John Gillies, M.B., Simpson Reader in Anaesthetics, the University of Edinburgh, and director, Department of Anaesthetics, Royal Infirmary of Edinburgh, Scotland, will speak on the subject "The Effect of Nationalization of Medicine on the Specialties in England."

LIFE INSURANCE MEDICAL RESEARCH FUND RESEARCH GRANTS AND FELLOWSHIPS

Applications for grants in aid of research on cardiovascular problems in 1951 will be received by the Life Insurance Medical Research Fund up to November 15, 1950. Support is available for physiological, biochemical and other basic research that bears on cardiovascular problems, as well as for clinical investigation in this field. Preference is given to fundamental research. It is expected that about $550,000 will be awarded for these grants.

Applications for postdoctoral fellowships for training in research in 1951-52 will also be received by the Fund up to November 1, 1950. Preference is given to candidates who wish to work in the broad field of cardiovascular function or disease and to candidates who wish to work in institutions other than those in which they have obtained most of their experience. A doctor's degree (M.D. or Ph.D.) or the equivalent is required. The annual stipend varies, as a rule being between $3000 and $4000, with larger amounts in special cases. At least 15 postdoctoral fellowships will be available.

New grants and fellowships will become available on July 1, 1951.

A number of predoctoral fellowships for basic training in research will also be awarded. Details are available on request.

Further information and application blanks may be obtained from the Scientific Director, Life Insurance Medical Research Fund, 2 East 103rd Street, New York 29, New York.

(*Notices concluded on page xvii*)

NOTICES (*Concluded from page 512*)

SOCIETY MEETINGS AND CONFERENCES

OCTOBER 3. Massachusetts Academy of General Practice. Boston City Hospital and Hotel Kenmore.

OCTOBER 3. Conference on Alcoholism. Page 430, issue of September 14.

OCTOBER 3 AND 4. Massachusetts Chapter, American Academy of General Practice. Page 430, issue of September 14.

OCTOBER 4–24. The Springfield Hospital. Page 470, issue of September 21.

OCTOBER 6–MAY 11. Massachusetts Department of Mental Health. Postgraduate Seminar in Neurology and Psychiatry. Page 324, issue of August 24.

OCTOBER 9–11. National Gastroenterological Association. Page 470, issue of September 21.

OCTOBER 9–20. New York Academy of Medicine. Page 430, issue of September 14.

OCTOBER 10. Massachusetts Society of Anesthesiologists. Page 430, issue of September 14.

OCTOBER 10. Springfield Academy of Medicine. Page 512.

OCTOBER 12–14. American Association of Blood Banks. Page 428, issue of March 16.

OCTOBER 13. Chemotherapy — New Preparations, Their Efficacy and Effects. Dr. Chester S. Keefer. Pentucket Association of Physicians. 8:30 p.m. Haverhill.

OCTOBER 14–19. American Academy of Pediatrics. Page 962, issue of June 15.

OCTOBER 17. South End Medical Club. Page 512.

OCTOBER 23–27. American College of Surgeons. Page xi, issue of June 29.

OCTOBER 23–28. Medicomilitary Symposium for Officers of Fourth Naval District. Page 34, issue of July 6.

OCTOBER 28. Massachusetts Association of Medical Technologists. Page 324, issue of August 24.

OCTOBER 30–NOVEMBER 3. American Public Health Association. Page 240, issue of August 10.

OCTOBER 31–NOVEMBER 3. International College of Surgeons. Page 170, issue of July 27.

NOVEMBER 1. New England Obstetrical and Gynecological Society. Hotel Somerset, Boston.

NOVEMBER 1. Hampshire District Medical Society. Page 170, issue of July 27.

NOVEMBER 5 AND 6. American Society for the Study of Arteriosclerosis. Page 170, issue of July 27.

NOVEMBER 6–8. New England Postgraduate Assembly. Hotel Statler, Boston.

NOVEMBER 10. American Trudeau Society. Page 280, issue of August 17.

NOVEMBER 14. New England Society of Anesthesiologists. Page 512.

JANUARY 31. American Academy of Orthopaedic Surgery (see Kappa Delta Award for Research in Orthopedic Surgery). Page 736, issue of May 4.

FEBRUARY 13. New England Society of Anesthesiologists. Page 512.

APRIL 9–13. American College of Physicians. Page 962, issue of June 15.

APRIL 10. New England Society of Anesthesiologists. Page 512.

MAY 8. New England Society of Anesthesiologists. Page 512.

MAY 24–26. American Goiter Association. Columbus, Ohio.

DISTRICT MEDICAL SOCIETY

HAMPSHIRE

NOVEMBER 1. 4:30 p.m. Northampton State Hospital.
JANUARY 3. 4:30 p.m. Veterans Administration Hospital, Northampton.
MARCH 7. 4:30 p.m. Cooley-Dickinson Hospital, Northampton.
MAY 2. 4:30 p.m. Annual Meeting. Jones Library, Amherst.

CALENDAR OF BOSTON DISTRICT FOR THE WEEK BEGINNING THURSDAY, OCTOBER 5

THURSDAY, OCTOBER 5

*9:00–10:00 a.m. Cardiac Grand Rounds. Main Amphitheater, Children's Medical Center.

FRIDAY, OCTOBER 6

*9:00 a.m.–12:00 m. Combined Medical and Surgical Staff Rounds. Peter Bent Brigham Hospital.
*10:00 a.m. Surgical Clinic. South End Health Unit, 57 East Concord Street, Boston.
*1:30 p.m. Tumor Clinic. Out-Patient Department, Mount Auburn Hospital, Cambridge.

MONDAY, OCTOBER 9

*11:30 a.m.–12:15 p.m. Clinical Conference. South End Health Unit, 57 East Concord Street, Boston. Dr. Cleaveland Floyd in charge.
*12:15–1:15 p.m. Clinicopathological Conference. Main Amphitheater, Peter Bent Brigham Hospital.

TUESDAY, OCTOBER 10

*12:15–1:15 p.m. Clinicoroentgenological Conference. Peter Bent Brigham Hospital.
*1:30–2:30 p.m. Pediatric Rounds. Burnham Memorial Hospital for Children, Massachusetts General Hospital.

WEDNESDAY, OCTOBER 11

*12:00 m. Clinicopathological Conference. Margaret Jewett Hall, Mount Auburn Hospital, Cambridge.
*12:00 m.–1:00 p.m. Clinicopathological Conference. (Children's Medical Center.) Amphitheater, Peter Bent Brigham Hospital.

*Open to the medical profession.

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